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FACULTADES DE CIENCIAS QUÍMICAS, INGENIERÍA Y MEDICINA

PROGRAMAS MULTIDISCIPLINARIOS DE POSGRADO EN CIENCIAS AMBIENTALES

AND

COLOGNE UNIVERSITY OF APPLIED SCIENCES

INSTITUTE FOR TECHNOLOGY AND RESOURCES MANAGEMENT IN THE TROPICS AND SUBTROPICS

"FINANCIAL MECHANISM FOR CONSERVATION: WATER FUND TO PROTECT THE WATER FOREST"

THESIS TO OBTAIN THE DEGREE OF

MAESTRÍA EN CIENCIAS AMBIENTALES

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FOCUS AREA "ENVIRONMENTAL AND RESOURCES MANAGEMENT"

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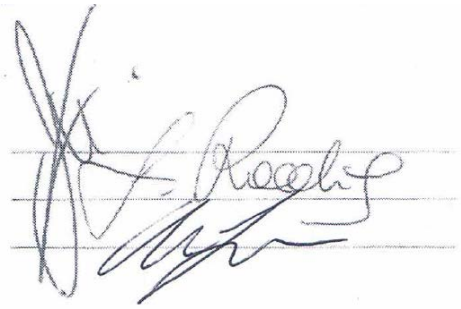

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ABSTRACT

The Water Forest is a forest continuum of 235,000 hectares shared by three states (Morelos, Estado de México and Distrito Federal) and one of the most important biological and hydrological regions in Mexico. Over the last 40 years, forest coverage has shrunk in some regions between 27 and 35 per cent, while urban sprawl has increased up to 400 per cent in the same time period - even at the expense of protected areas (8 federal, 12 state and 6 municipal) (ECOBA 2012).

In similar conditions in other Latin American countries - water recharge areas are affected by the expansion of megacities like Quito, Lima or Bogota - water funds became a new mechanism to finance the protection of the ecosystem services. This economic mechanism permits downstream water users to pool their money to finance upstream land management that ensures a clean water supply available year-round. Even if it seems that the water fund could offer a solution to protect the WF - there is no investigation about the opportunities by implementing such financing mechanism in this area.

The study aims to fill this gap by identifying the opportunities and establishing recommendations for the implementation of a water fund in the Water Forest.

Based on the methodology of the Latin American Water Funds Partnership (ALFA), conservation priorities, funding opportunities, and potential stakeholder participation of the influence area of the water fund were identified and analyzed in the present study. The conservation priorities and funding opportunities for the water fund were identified due to a geographical analysis by four categories: high biological significance, vulnerability to anthropogenic activities, aptness for reforestation and soil erosion control projects, and special land tenure properties. The relevant stakeholders were identified and grouped by its interest and influence in the implementation of a water fund. 15 in-depth interviews have been conducted to get detailed information about the potential stakeholder participation and the ongoing conservation efforts in this area. The study concludes by proposing recommendations for the implementation of the water fund for every priority and every stakeholder selected.

Key words: Water fund, financial mechanism, basin of Mexico, Water Forest.

RESUMEN

El Bosque de Agua es una región de 235,000 hectáreas que abarca tres Estados (Morelos, Estado de México y Distrito Federal) y una de las regiones con mayor importancia biológica e hidrológica de México. En los útlimos 40 años la cubierta forestal se ha reducido en algunas regiones entre el 27 y 35 por cierto, mientras que la expansión urbana se ha incrementado hasta en un 400 por ciento en el mismo periodo de tiempo, incluso a expensas de áreas naturales protegidas (8 federales, 12 estatales y 6 municipales) (ECOBA 2012).

En condiciones similares en otros países de Latino América, donde las zonas de recarga de agua se han visto afectadas por la expansión de de megaciudades como Quito, Lima y Bogotá, los fondos de agua se han convertido en un mecanismo nuevo para financiar la protección de los servicios ecosistémicos. Este mecanismo económico permite a los usuarios de la parte baja de la cuenca aportar dinero para financiar la gestión de la tierra en la parte alta de la cuenca; y de esta forma asegurar que el suministro de agua este disponible todo el año. Aunque el fondo de agua podría ser una solución para proteger el Bosque de Agua, no hay ninguna investigación acerca de las oportunidades de implentar un mecanismo financiero como éste, en esta área.

El estudio tiene como objetivo atender este vacío mediante la identificación de las oportunidades y la elaboración de recomendaciones para la implementación de un fondo de agua en el Bosque de Agua.

Con base en la metodología de la Alianza Latinoamericana de Fondos de Agua (ALFA), se identificaron y analizaron las prioridades de conservación, las oportunidades de financiamiento y el potencial de participación de los actores claves de la zona de influencia del fondo de agua. Las prioridades de conservación y oportunidades de financiamiento fueron identificadas con base en un sistema geográfico y clasificadas en cuatro categorías: alta importancia biológica, vulnerabilidad a actividades antropogénicas, idoneidad para la reforestación y proyectos de control de erosión, y características específicas de la tenencia de la tierra. Los actores claves fueron identificados y agrupados por su interes e influencia en la implementación de un fondo de agua. Se realizaron 15 entrevistas para obtener información detallada acerca del potecial de participación de los actores claves y sobre los esfuerzos de conservación en curso en esta área. El estudio concluye proponiendo recomendaciones para la implementación del fondo del agua de acuerdo a cada prioridad y actor clave identificados.

Palabras clave: Fondo de agua, mecanismo financiero, Cuenca del Valle de México, Bosque de Agua.

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ACRONYMS AND ABBREVIATIONS

ALFA	Alianza Latinoamérica de Fondos de Agua
	Latin American Water Funds Partnership
AMSA	Agua de México S.A
	Water of Mexico
ANEAS	Asociación Nacional de Empresas de Agua y Saneamiento de México
	National Association of Water and Sanitation of Mexico, AC
AWP	Annual Action Programs
BANOBRAS	Banco Nacional de Obras y Servicios Públicos
	National Bank of Public Works and Services
CAEM	Comisión del Agua del Estado de México
	Water Commission of the State of Mexico
CBD	Convention on Biological Diversity
CCMSS	Consejo Civil Mexicano para la Silvicultua Sostenible
	Mexican Civil Council for Sustainable Silviculture
CEDUA - COLMEX	Centro de Estudios Demográficos, Urbanos y Ambientales - Colegio de México
	Center for Demographic, Urban and Environmental Studies - College of Mexico
CETAMEX	Centro de Estudios de Tecnologías Apropiadas para México, A.C.
	Research Center of Appropriate Technologies for Mexico, AC
CFE	Comisión Federal de Electricidad
	Federal Electricity Commission
CI	Conservation International
COLMEX	Colegio de México
	College of Mexico
CONABIO	Comisión Nacional para el Conocimiento y Uso de la Biodiversidad
	National Commission for the Knowledge and Use of Biodiversity
CONAFOR	Comisión Nacional Forestal
	National Forest Commission
CONAGUA	Comisión Nacional del Agua
	National Water Commission
CONANP	Comisión Nacional de Áreas Naturales Protegidas
	National Commission of Natural Protected Areas
COP	Conference of the Parties
COTAS	Comités Técnicos de Aguas Subterráneas
	Technical committees for subterranean waters
CSO	Civil society organization
CTF	Conservation Trust Funds
DF	Distrito Federal
	Federal District
EDOMEX	Estado de México
	State of Mexico
EMA	Estaciones Meteorológicas Automáticas
	Automated Weather Stations
EMAAP	Empresa Metropolitana *de* Alcantarillado *y* Agua Potable de Quito
	Quito Metropolitan Sewage and Public Water
FAMM	Fondo de agua de Monterrey
	Mexican water fund of Monterrey
FANMex	Freshwater Action Network Mexico
FANP	Fondo para Áreas Naturales Protegidas
	Protected Area Fund
FGRA	Fundación Gonzalo Río Arronte, I.A.P.
	Río Arronte Fundation
FMCN	Fondo Mexicano para la Conservación de la Naturaleza
	Mexican Nature Conservation Fund

FEMSA	Fomento Económico Mexicano
	Mexican Economic Development
FONADIN	Fondo Nacional de Infraestructura
	National Infrastructure Fund
	Fondo de Agua de Quito
FONAG	Quito Water Fund
FONAPA	Fondo de Agua de Colombia
	Columbian Water Fund
	Fundación Biósfera del Anáhuac A.C.
FUNBA	Anahuac Biosphere Foundation
	Fondo Semilla de Agua
FSA	Water Seed Fund
GEF	Global Environment Facility
GDI	Biological Importance Index
GIZ	German Development Cooperation
GWP	Global Water Partnership
HCVA	High Conservation Value Areas
IASA	Industrias del Agua, S.A.
	Water Industry
IBA	Important Bird Areas
ICRA	International Centre for development oriented Research in Agriculture
IDB	Inter-American Development Bank
IMTA	Instituto Mexicano de Tecnología del Agua
	Mexican Institute of Water Technology
INECC	Instituto Nacional de Ecología y Cambio Climático
	National Institute of Ecology and Climate Change
InVEST	Integrated Valuation of Ecosystem Services and Trade-offs Tool
IS	Asentamientos irregulares
	Irregular settlements
IUCN	International Union for Conservation of Nature
LAC	Latin-America countries
LGEEPA	Ley General del Equilibrio Ecológico y la Protección al Ambiente
	General Law *of* Ecological Balance and Environmental Protection
MC	Movimiento Ciudadano
	Citizens Movement
MINAM	Ministerio del Ambiente de Perú
	Ministry of Environment of Peru
NGO	Organización no gubernamental
	Non-governmental Organizations
OECD	Organisation for Economic Co-operation and Development
PA	Protected Areas
PAOT	Procuraduría Ambiental y del Ordenamiento Territorial de D.F.
	The Environmental Attorney and Federal Land Management District
PNA	Partido Nueva Alianza
	New Alliance Party
PRD	Partido de la Revolución Democrática
	Party of the Democratic Revolution
PRI	Partido Revolucionario Institucional
	Institutional Revolutionary Party
Probosque	Protectora de Bosques del Estado de México (Secretaría del Medio Ambiente)
PROFEPA	Procuraduría Federal de Protección al Ambiente
	Federal Attorney for Environmental Protection
PROCER	Programa de Conservación de Especies en Riesgo
	Conservation Program for Species at Risk
PSA	Pago por Servicios Ambientales
	Payment for Environmental Services

PT	Partido del Trabajo
	Labor Party
PVEM	Partido Verde Ecologista de México
	Green Ecologist Party of Mexico
RAMSAR	Convention on Wetlands of International Importance
RedLAC	Network of Environmental Funds in Latin America and the Caribbean
SACMEX	Comisión del Agua del Distrito Federal
	Water Commission of the Federal District
SAGARPA	Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación
	Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food
SAPSA	Servicios de Agua Potable S.A.
	Drinking Water Services
SEDATU	Secretaría de Desarrollo Agrario, Territorial y Urbano
	Mexican Ministry of Agricultural, Land and Urban Development
SEDAPAL	Servicio de Agua Potable y Alcantarillado de Lima
	Drinking Water and Sewerage Service
SEDUVI	Secretaría de Desarrollo Urbano y Vivienda
	Ministry of Housing and Urban Development
SEDEMA	Secretaría del Medio Ambiente de la Ciudad de México
	Ministry of Environment of the Federal District
SEMARNAT	Secretaría de Medio Ambiente y Recursos Naturales
	Ministry of Environment and Natural Resources
SHCP	Secretaría de Hacienda y Crédito Público
	Mexican Secretary of Finance and Public Credit
SIMEC	Sistema de Información, Monitoreo y Evaluación para la Conservación
	Information, Monitoring and Evaluation System for Conservation
SIDA	Swedish International Development Cooperation Agency
SINAP	Sistema Nacional de Áreas Protegidas
	National System of Protected Areas
SUNASS	Superintendencia Nacional de Servicios de Saneamiento
	National Superintendence of Sanitation Services
SWAT	Soil and Water Assessment Tool
TECSA	Tecnología y Servicio de Agua S.A.
	Technology and Water Service
TNC	The Nature Conservancy
UAM	Universidad Autónoma Metropolitana
	Autonomous Metropolitan University
UNAM	Universidad Nacional Autónoma de México
	National Autonomous University of Mexico
UNAM-FC	Facultad de Ciencias, Universidad Nacional Autónoma de México
	Faculty of Science, National Autonomous University of Mexico
UNDP	United Nation Development Program
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
WF	Bosque de Agua
	Water Forest
WWC	World Water Council
WWF	World Wildlife Fund

1 Background

1.1 Water Forest

In 2006, Hector Magallón (Greenpeace) introduced the definition and zoning of the region called "Water Forest". He proposed a project, undertaken by Greenpeace in 2006 -2008, to integrate the Forests located in the south of the Mexico City Basin, the southeast of the Lerma Basin and the northern part of the Balsas Basin into a single region. The concept of the name was revived by the name of the Volcano Ajusco in Náhuatl, called *Axosco* or *Axochco* (Ajusco, in Spanish), which means "place where the water flows "or" water forest" (Ortega and Medina 1987 in: Hoth 2012a).

The Water Forest (WF) is confined to an area of 2,350 km² (235,000 ha) in the mountain corridor known as the *Sierra de Chichinautzin* and *Sierra de Las Cruces* (Figure 1: Location of the Water Forest). the region is part of the Trans-Mexican Volcanic Belt that extends 900 km from the pacific coast to the east across central-southern (Demant 1978). About 60 % of the WF is located in the State of Mexico and approximately 20 % in both the Federal District and the State of Morelos (ECOBA, 2012). The region is known for its unusually high number of endemic species of amphibians, reptiles, birds and mammals (López-Morales 2012, p. 17). It forms part of one of the most important regions in Mexico, as measured by the Biological Importance Index (GDI) based on 47 variables, including primary vegetation cover, number of vegetation types, number of endemic vertebrate, species of plants and vertebrates included in the federally endangered vertebrate species list NOM-059-SEMARNAT-2010 (SEMARNAT 2010). The National Commission for the Knowledge and Use of Biodiversity (CONABIO) considered the region as a high national priority due to its biological diversity, levels of vulnerability and hydrological importance (CONABIO 2006).

In this last regard, the region constitutes the main water recharge source of 10 aquifers which provide two thirds of the water consumed by more than 22 million inhabitants. The area constitutes the head of four watersheds: Alto Balsas, Alto Lerma, Pánuco and Valle de Mexico (Figure 2: Four watersheds related to the

Water Forest). The forested region also provides water for two RAMSAR sites: Ciénegas de Lerma and the World Heritage Site of Xochimilco.

Figure 1: Location of the Water Forest.

Distribution of the Water Forest in the Sierra de Chichinautzin and Sierra de Las Cruces

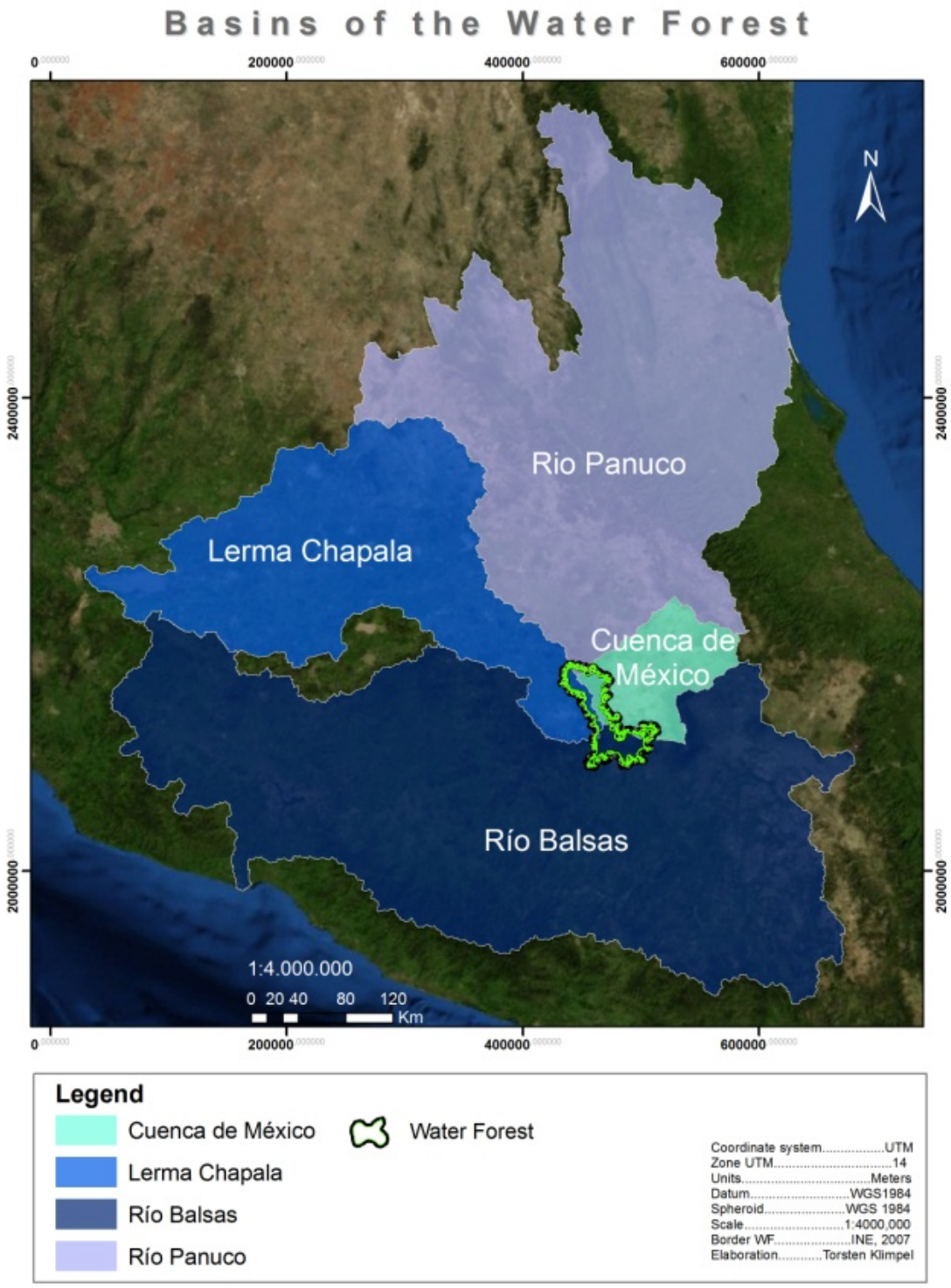


Figure 2: Four watersheds related to the Water Forest.

The area of the water forest constitutes the head of Alto Balsas, Alto Lerma, Pánuco and Valle de Mexico. The area belongs only to a small part to the Pánuco basin

1.2 Development of water funds in Latin-American countries

The provision of the inhabitants of megacities in Latin American depends on an intact surrounding ecosystem, into the same watershed or neighboring watershed. A natural ecosystem can improve or maintain water quality and water quantity for the population; regular flows of water or avoid costs of water treatment (Goldman et al. 2010). Although large parts of the private sector continue to rely on natural resources, the government seems to be the only one covering the costs of the ecosystem's protection (IFC 2006).

Over the last decade, the environmental organization The Nature Conservancy (TNC) started to search for a conservation mechanism that both involves the private sector in the conservation of the ecosystem and generates long term finance independently of governmental changes. TNC implemented, in collaboration with numerous partners, the "Northern Tropical Andes Program" and initiated a series of ecosystem services projects called water funds. "Water funds are based on the premise that natural ecosystems and conservation management practices by people living upstream in the watershed can help provide a clean, regular supply of water and that downstream service users (including water utility companies, hydropower companies, and other industries) who depend upon these services should pay for their maintenance and persistence" (Goldman et al. 2010 p.1).

The Quito Water Fund FONAG was the first such mechanism created in Latin America supported by TNC. It was created in 1997 in response to the city of Quito´s need for water supply and the limited funding received for watershed protection. Three years later and with a capital of USD 21,000 the fund was established by the Quito Metropolitan Public Water and Sanitation Company (EMAAP in Spanish) together with TNC. Today FONAG has a background capital of USD 10 million for watershed conservation projects to ensure the water supply for Quito (Ortega-P et al. 2013). The resources are invested in four protected areas: Cayambe-Coca, Antisana, Cotopaxi, and Ilinizas.

More than 30 Water Funds have been launched throughout the world, in places as varied as shown in Table 1: Overview on selected Water funds. The water funds differ in its objectives, amount of capital and time of existence. Even most of the

water funds have been implemented in the last 20 years; the capital has increased quickly up to 10 million US$ Dollar. Based on this experience, TNC, the Inter-American Development Bank (IDB), the Global Environment Facility (GEF) and the Foundation "Fomento Económico Mexicano (FEMSA)" decided to create in 2011 the "Alianza Latinoamerica de Fondos de Agua (ALFA)". The alliance aims to replicate and improve the model with local partners in other countries, including Bolivia, Brazil, Colombia, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Peru and Dominican Republic. The objective is to create 32 Water Funds by 2016 to conserve 3 million acres (1,214,056 ha) of watersheds in Latin America and the Caribbean, in order to provide water for at least 50 million people, (Ortega-P et al. 2013). The ALFA initiative decided to invest in three water funds in Mexico one is already operating (Chiapas), one is still in the design and implementation process (Monterrey) and the other in the feasibility stage (Yucatan).

Table 1: Overview on selected Water funds

Name	Watershed or Associated City	Promoter	Formation	Capital (US$ Dollar)	Objectives
Mexican Water Funds					
Fondo pro Cuenca Valle de Bravo, A.C.	Valle de Bravo, Mexico	FANMex, FGRA; FEMSA; Pedro y Elena Hernández Foundation; Modelo Foundation, CONAGUA, SEMARNAT, CONANP, Probosque	2000	380.000 (in 2012)	Community development; Fostering policies and financial conditions to protect, conserve and restore the hydrological basin.
Cuencas y ciudades	Mexico (different cities)	FGRA, FANP, FEMSA, FMCN	2001	Project financed by other funds, cost are not known	Civil society organization (CSO) promotes linking the city with its recharge zone, and the participation of citizens in decision-making and integrated resource management.
Fondo Semilla de Agua – Chiapas	Hydroelectric System Grijalva; Chiapas Mexico	Federal and State Government, TNC, FEMSA,IDB, GEF, Coca Cola Company, Fondo de Conservación el Tríunfo, CONAFOR, CONANP, FMCN, CONAGUA, CFE, IMTA, Tierra Verde A.C.	2012	71.000 (2013)	Community capacity building, forest restoration, productive reconversion (such as conservation agriculture and silvopastoral systems), payments for ecosystem services, environmental research and education.
Fondo de agua Monterrey	Watershed San Juan, Monterrey, Mexico	Federal and State Government, TNC, FEMSA, IDB, GEF, CONAFOR, CONANP, FMCN, Pronatura Noreste	2013	Feasibility studies	Payments for ecosystem services, environmental education, research, restoration of urban creeks, prevention of land use change, community

		AC, Chipinque NP, ITESM Water Center, Universities of Nuevo León and Monterrey			training.
Fondo 1928	Valley of Mexico, Mexico	Federal District, State of Mexico, SHCP, CNA, BANOBRAS, CONAGUA General Division of Drinking Water, Sewerage and Sanitation),	1997	271.560.00 (in 2008)	Focuses on funding projects and water infrastructure works necessary to meet the water supply and, sanitation needs, stormwater and wastewater disposal in the Metropolitan Area of Mexico.
Latin-American Water Funds					
Fondo para la Protección del Agua (FONAG)	Quito, Ecuador	USAID, EMAAP , TNC	2000	10 Million (2012)	Control and Monitoring of Priority Areas, Water Management, Environmental Education, Recovery of Vegetation Cover, Communication.
Bogota	Bogota, Columbia	TNC, Bogota Water Facility, Colombian Protected Areas Agency, FEMSA, IADB, Sab Miller Bavaria Brewery	2009	1500000 (2010)	Reforestation, conservation, restoration, ecotourism, silvopastoral production systems.
Aguafondo	Lima and Callao, Peru	SEDAPAL, SUNASS, MINAM Ministry of Environment, GEA Group, TNC	2008	$1'000.000 (2010)	Maintain or enhance biodiversity and ecosystem services; communication; supporting governance processes for managing water resources; identify opportunities to avoid water treatment cost; achieve sustainable, long-term financing for conservation efforts.
International Water Funds					
Texas Water Opportunity Fund	Texas, USA	Waterfund LLC	2013	$2 billion	Achieve universal access to freshwater by enhancing capital investment in global water infrastructure. The money was transferred in 2013 from the Rainy Day Fund generated primarily by taxes on oil and natural gas production.
Washington Water Trust	Washington , USA	Dungeness Water Users Association, Clallam County, Jamestown S'Kallam Tribe, Department of Ecology - State of Washington	1998	n.d.	Leveraging funds for project that benefit stream flow, providing education, outreach and support, Reverse water right auctions, Water banking facilitation and mitigation strategies, designing water right management alternatives, Facilitating water use changes.

The fresh water trust	Portland, USA	n.d.	1982	4481000 (2012)	Best management practices in agriculture, large wood placement, stream realignment & reconnection, water quality trading, watershed - wide cooperation.
Africa Water, Sanitation and Hygiene Fund WSAH	African countries	n.d.	1988	USD 12 million (in 2011)	Development of innovative and sustainable approaches, evidence-based policy advice and advocacy services for water, sanitation and hygiene services provision in Africa.

Table 1: Overview on selected Water funds. The table represents just a small selection of water funds. In the international context it was difficult to get information about the organizations participating in the water fund. The project “Cuencas y ciudades” of FMCN was adopted in the analysis due to the similar objective of water funds.

2 Research

2.1 Problem statement

2.1.1 Pressures on the Water Forest

The Mexican government has recognized the importance of the WF for Mexico City, Morelos and the State of Mexico. There are 24 protected areas in the Water Forest of which eight are managed by the federal government, 10 by the States, and six are community conservation areas (ECOBA 2012). Among them is the first decreed protected area of Mexico, the “Desierto de los Leones”, established in 1917 (Gallegos and Garcia 1993). Over 70 % of the Water Forest has been recognized as a priority for conservation, either as a Priority Terrestrial Region, an Hydrological Region of National Priority (Conabio, 2000 and 2002 respectively) and as an Important Bird Area (Arizmendi 2000 in: ECOBA 2012).

However, the existing measures have not been sufficient yet. Land use change by deforestation, urbanization and fragmentation by roads is the main threat in this region. Over the last 40 years, forest coverage has shrunk in some regions between 27 and 35 per cent, while urban sprawl has increased up to a 400 per cent in the same time period (ECOBA 2012, p. 19). These changes in land use often result in irreversible changes to the habitat whose component species are destroyed and replaced (Ehrlich and Kremen 2001). The population in the Metropolitan Area of the Valley of Mexico also increased from 700,000 inhabitants in 1920 to 3,480,000 in 1953. Currently, there are over 24 million people living in this area. The most populous state in the country is the State of Mexico with 15,175,862 inhabitants and the Federal District (DF) is the second with 8,851,080 inhabitants, and both are bordered by the Water Forest (INEGI, 2010).

As result of the population growth 1249 wells have been established inside the WF and around 5300 wells in total are extracting 46.7 m^3/s of 10 aquifers connected to the Water Forest (Table 2: Water extraction from the Water Forest (WF). However, the water resources are not unlimited: 29 % of the Valley of Mexico’s aquifers, 35 % of the Alto Lerma’s aquifers and 4 % of the Balsas’s aquifers are overexploited (OECD 2010, p. 6). Around 20 % of the population that lives in the Valley of Mexico has access to a scarce165 m^3/person/year (OECD 2010, p. 7). In

comparison, areas with less than 1,700 m³/person/year of mean natural availability of water can be considered to be in a condition of water stress. Other alternatives to satisfy the water consume from other recharge areas are also not feasible and highly expensive. A study published by the Mexican National Institute of Ecology and Climate Change (INECC) has shown that water extraction from the following alternatives would cost 31.2 billion[1] US dollars: Amacuzac River, Tecolutla, Oriental-Libres, Temascaltepec and Taxhimay (López-Morales 2012, p. 17).

Table 2: Water extraction from the Water Forest (WF)

Indicators	Region WF	Central region[2]
Extraction of water m³/s	16.5	46.7
Number of wells	1249	5300
Number of persons (millions)	5.99	28.8
Replacement cost (billions of dollars)	6.2	31.2

Source: López-Morales 2012

[2]Includes the 10 aquifers connected to the Water Forest

According to the dates of land use change by Hoth (2012), the growth of the urban area in the Federal District has caused a reduction of agricultural areas by an annual rate of 7.4 % and of green areas at an annual rate of 3.7 % (Hoth 2012 p.41). The forested area of the WF has been fragmented and forest coverage decreased by over 20 % between 1976 and 2008. The transformation of nature-near forest caused over 85 % of this change. Around 18.5 km² was changed by urbanization, 13.2 km² by agriculture, 2.86 km² by cultivated grassland and 2.4 km² by secondary deciduous forest (López-Morales 2012, p. 19). Federal and state highways fragment 38 per cent of the region, wherein at least three toll roads represent barriers for wildlife. In addition, there are three other road projects planned; highway Lerma-Tres Marías, Arco Sur and Toluca-Huixquilucan-Naucalpan (Hoth, 2012).

There are various reasons responsible for the failure of the existing environmental policy instruments. Even though the Mexican government has established 24

[1] Refers to the U.S. counting

Protected Areas, only a third of these have management programs and even less have staff and resources allocated for its administration (Hoth 2012a). Furthermore, the government implements policies that are aimed at increasing economic activities like agricultural subsidies or land re-distribution programs. These may in turn encourage the use of more environmental resources such as land and water for those activities and thus result in ecosystem degradation and reduced biodiversity (Kodzo 2012). In addition, the environmental policies are shaped by the different interests of the various stakeholders of this region. The area of the water forest is divided into three different states and 37 municipal governments have a jurisdiction in the area. In the past, this has caused individual - and partly opposed - conservation measures.

2.1.2 Lack of resources for protected areas

The TNCs Northern Andes program started to work in protected areas essential for water-related services such as a clean and regular supply of surface water flows (Goldman et al. 2010, p. 3). Most of the areas in Ecuador, Colombia, northern Venezuela and northern Peru do not address the link between protected area management (the ultimate water source) and drinking water (Echeverria 2002; Benitez et al. 2010). Furthermore, the investment in the conservation of these water sources, i.e., protected area boundaries, is not sufficient. This results in financial gaps throughout the Northern Andean countries in protected-area annual budgets (Goldman et al. 2010, p. 3). According to the results of a study from 19 Latin-America countries (LAC) conducted by UNDP and TNC in 2008, show that the total available resources for protected areas (PA) systems are approximately $402 million per year. Estimation on the basic management needs for national PA systems show a financing gap (available funds minus financial needs) of $314 million/year (excluding Venezuela) to simply address basic management activities for PAs. This regional funding gap is particularly concerning, considering that LAC contains almost 40 percent of the Earth's biodiversity (Bovarnick et al. 2010).

Protected areas in Mexico represent almost 10.4 per cent of the country's land surface and 1.5 per cent of its marine zones however the available resources are $80,214,239 million per year, which equals $3.47/ha/year (Bovarnick et al. 2010)

In comparison, the average of total available funds within the LAC is $1.95 /ha/year, in the middle East $5.40/ha/year, Eastern Europe $11.20/ha/year, and the European Union $43.00/ha/year (Bovarnick et al. 2010). More than 60 % of the money is spent by the Mexican government and only 4 percent of the financing has been reached by donor funds - included both public (bilateral or multilateral international cooperation) and private sources (private foundations, individual donors, and NGOs, among others) (Bovarnick et al. 2010). An effective management requires a budgetary increase of 287 % over the next eight years, representing an investment of US$ 2 billion over this time frame (Bezaury-Creel et al. 2011). This amount cannot be covered only by the government. The financing of protected areas need more participation of national and international resources and has to include more diverse the public and private funding.

2.1.3 Regional strategy for the conservation of the Water Forest

In July 2010 a group of NGOs (FUNBA, Reforestamos México and Pronatura México), government organizations (INE, PAOT, CONANP and CONAFOR) and educational institutions (COLMEX and UNAM) created the “Initiative Water Forest”. The purpose of this initiative is to develop and implement a regional strategy for the WF’s conservation and sustainable development, promote effective citizen participation, driven through network collaboration, leading regional sectors of society to claim the value, use and importance of ecosystem services.

One year later, the Mexican Gonzalo Río Arronte foundation accepted the tender of a project of this working group to support the development of a regional strategy for the conservation of the Water Forest. The strategy was developed from August 2011 to January 2012 by doing interviews with diverse stakeholders and four workshops carried with around 200 participants from more than 80 organizations. As a result of this process 99 priority themes were identified and 263 related actions were recommended in relation to eight strategic lines.

One of the strategic lines “Financing mechanism” has the objective to identify and promote economic instruments to finance the conservation and sustainable use of the WF.

2.1.4 Water fund for the watershed of the Mexican valley

In Mexico there are already three water funds initiated by the ALFA and since May 2014 TNC starts a new initiative to implement a water fund in the watershed of the Mexican valley (Figure 2: Four watersheds related to the Water Forest) (Hesselbach, H., personal communication, 2014). With the financial support of FEMSA Foundation, Banamex, PepsiCo Foundation and the technical support of the Gonzálo Río Arronte Foundation; TNC ordered the development of several baseline studies, inter alia: biophysical studies (hydrological and ecological), social studies (stakeholder analysis), economic studies (economic valuation studies), legal – institutional studies (laws, regulations, plans and programs on water, land management, protected areas) for environmental services, or cross-sectional studies (Geographic Information System and Monitoring system). According to the results of these studies, the first conservation pilot project will be implemented in the Mexican Valley in the end of 2015.

The Mexican Valley watershed forms part of the WF (Figure 2: Four watersheds related to the Water Forest). Of the total water recharge in the *Sierra Chichinautzin*, 60 % flows down into the Valley of Mexico and of the *Sierra de las Cruces*, 70 % flows into the Valley of Mexico (Ortega 1989). The high significance of the Water Forest as a recharge area for the Valley of Mexico makes it a priority area for further conservation.

2.1.5 Water fund for protecting the Water Forest

Resuming the previous chapter, the WF forms part of one of the most important biological and hydrological regions in Mexico and the conservation efforts of the Mexican government have not been sufficient yet. There are insufficient resources to the low financial support from private sources and bilateral or multilateral international cooperation. Although there are different single private initiatives to protect the ecosystem services of the WF; they have limited impact in counteracting deforestation, urbanization and fragmentation of the WF.

The Initiative Water Forest has shown that there is a high interest from different sectors to collaborate in protecting the WF, but it requires financial resources to ensure the development of action plans and the implementation of long-term conservation measures. It needs a mechanism that can channel the resources of

the entire stakeholders and operate in a common purpose and a clear decision making mechanism.

Similarly in other Latin American countries - water recharge areas are affected by the expansion of megacities like Quito, Lima or Bogota - water funds have become a common mechanism to finance the protection of ecosystem services (Ortega-P et al. 2013). This economic mechanism offers the opportunity to channel resources from different stakeholders to finance long-term ecological restoration and biodiversity protection. The positive development of the instrument led to the creation of the ALFA by private, multilateral and non-governmental organizations to promote the implementation of water funds in different Latin-American countries (Ortega-P et al. 2013).

In May 2014, TNC started the initiative to implement a new water fund in the Mexican Valley. The area of the water forest linked to the watershed of the Mexican Valley can be financed in the future by the new water fund. Several private foundations support the first stage of developing the feasibility studies, the financial basis for further success.

Successful long-term conservation of the water forest a long-term investment is required. Water funds are created to secure investment to conserve the watershed in the future. The objective of creating capitalization funds is to obtain income returns over time. These funds may be valid for up to eighty years, as is the case of the Ecuadorian water fund FONAG. It allows long-term conservation agreements with land owners located in the basins (Calvache et al., 2012).

Water funds are transparent financial mechanisms. Resources generated by the funds can only be used for the purposes for which all future conservation actions have to be evaluated by scientific research and monitored over time. The fund manager entity is responsible for ensuring the proper use of money. This generates confidence among the contributors to the fund and allows transparent accountability (Calvache et al. 2012).

Due to the high amount of people and different organizations in the Metropolitan area of the Mexican valley, the water fund can be a platform for an integrated water resource management. The fund allows the channeling of new national and international resources by different sectors (including the private sector) and

motivates the collaboration of public and private sectors for the management of the protected areas. Communication can improve relationships between the local communities, the private sector, the governmental organizations and NGOs.

Even if it seems that the water fund could offer a smart solution to protect the WF - there is no investigation about the opportunities by implementing such financing mechanism in this area. In the past were conducted different studies and programs to search for financial opportunities for this area. The National Forest Commission launched in 2003 its Hydrological Environmental Services Programme which stabilized a Payment for Environmental Services (PES) scheme investing earmarked water use fees into conservation of forest cover in priority areas to protect the hydrological resources. In 2013 TNC launched with several organizations (Reforestamos Mexico, Pronatura, Grupo FEMSA etc.) the initiative to develop a Water Fund for the Water Forest. However due to the low interest of the private sector the initiative failed. Still an analysis of the opportunities of implementing a water fund in the WF is missing.

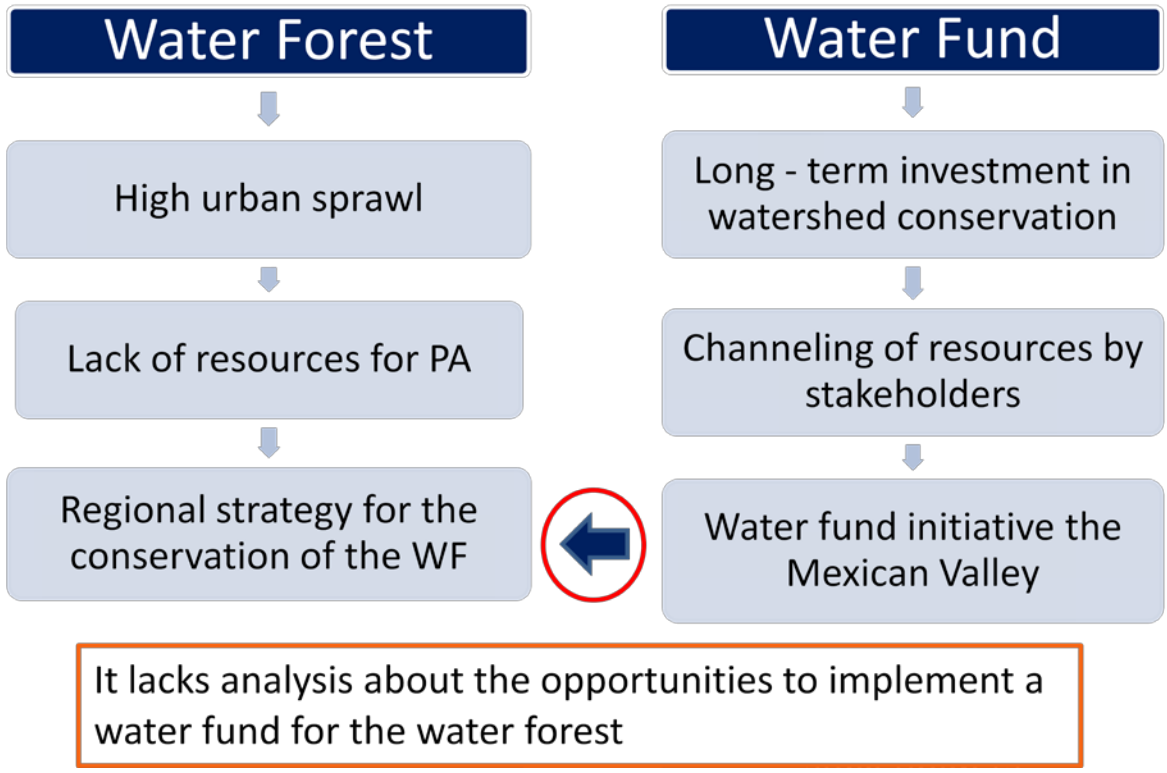


Figure 3: Relation between the Water Forest and the Water Fund

2.2 Research objective

2.2.1 General objective

Identify and analyze the key areas to implement a water fund in the Water Forest.

2.2.2 Specific objectives

1. Identify and analyze the funding opportunities for the water fund.
2. Identify and analyze the conservation priorities of the area of influence.
3. Identify and analyze the stakeholder participation in the water fund.

The identification of the key areas is the first step for designing, implementing and operating water funds. The key areas are analyzed by its conservation priorities, funding opportunities and potential stakeholder participation. The analysis focuses on the part of the Water Forest that belongs to the Mexican valley watershed, which is the area of influence of TNC. For the geographical boundary of the watershed I used INECCs' 2007 geographical data. The conservation areas are identified by hydrological and ecological significance and by urban threats. The stakeholder analysis concentrates on the institutions and organizations that belong to the area of influence.

3 Framework

3.1 Conceptual framework

3.1.1 Environmental policy instruments

“Economic instruments” and “Regulation and Control instruments” are the most widely known environmental policy instrument categories (Table 3: Classification of environmental policy instruments). Both are designed to encourage changes in the behavior of agents (Casey et al. 2006). In contrast to regulation and control instruments, economic instruments allow the agent to choose between degrading the ecosystem, polluting the environment and paying for it, or not to, and receive compensation (Moreno-Sánchez 2012, p. 11).

Table 3: Classification of environmental policy instruments

Environmental policy instruments	
Regulation and Control Instruments	Economic Instruments
Commodity Standards	Tools based on the change of behavior through prices: subsidies, taxes, charges of non-compliance, etc.
Rules on the use of natural resources	
Standards governing production processes	
Limits on emissions, effluents, solid waste	Tools based on the creation of markets: tradable permits, payments of environmental services, environmental insurance, certification and eco-labeling.
Standards on spatial planning	

Source: Azqueta et al. 2007 and (Moreno-Sánchez 2012, p. 11)

Since the 70s, environmental protection was enforced by regulation policy. The member countries of the Organisation for Economic Co-operation and Development (OECD) implemented laws to control the contamination of the air, water and soil (OECD 1994). These types of instruments were aimed at establishing limits on contamination and reducing pollution within the member countries. Regulation and control instruments could be relatively easy to design and implement, but they are inflexible for changes or adjustments (IUCN 2008). They are useful in protecting specific aspects of threatened biodiversity or to establish limits like emission regulation.

The environmental policy changed due to the conference in Rio de Janeiro in 1992. The parties agreed in the Convention on Biological Diversity (CBD 1992) to maintain the world´s biological diversity by three main goals: The conservation of biodiversity; sustainable use of the components of biodiversity; and sharing the benefits arising from the commercial and other utilization of genetic resources in a fair and equitable way (CBD 1992). To reach each of the main objectives, the convention identifies, besides a range of other measures and approaches, the use of economic instruments (Emerton 1998). As a result of the CBD, new economic instruments were developed to change incentive structures and to encourage people to conserve biodiversity in the course of their economic activities (Emerton 1998). Meanwhile regulatory methods tend to enforce or restrict certain activities that impact biodiversity; economic instruments may support and encourage activities to protect biodiversity. Economic instruments are rarely restricted by law, which makes them more adaptable and flexible (Moreno-Sánchez 2012, p. 11)

The Mexican budget for the environmental sector is low and under severe pressure from other sectors of the economy such as defense, health and education (Cámara de Diputados del H. Congreso de la Unión 27.12.2012). Regulation and control instruments like commodity standards or limits on emissions usually don´t generate funds for environmental protection or provide compensation payments (Emerton 1998). Economic instruments can generate and allocate new funds for biodiversity conservation and can be used to supplement and not replace other conservation strategies, such as existing regulations programs designed to conserve habitats and species (Casey et al., 2006). The international carbon trade, for example, grew from 2010 (US$126 billion) to 2011 (US$ 176 billion) by 11 % (Kossoy 2012). These changes have increased the interest of new actors to take part in environmental protection. Multilateral institutions like the World Bank, the Inter-American Development Bank, the European Union or international organizations, including the International Union for Conservation of Nature, (IUCN), Conservation International (CI), The Nature Conservancy (TNC) or the World Wildlife Fund (WWF) created funds for the purpose of financing biodiversity conservation, such as the Global Environment Facility (GEF).

3.1.2 Economic instruments for biodiversity conservation

Several economic instruments are currently being used for biodiversity conservation. Different organizations use different criteria for classification (Kodzo 2012). The United Nations Environment Programme (UNEP) distinguishes economic instruments into eight categories: property rights, market creation and enhancement, charges, fiscal instruments, financial instruments, financial assistance, liability instruments, environmental funds and economic instruments for biodiversity protection at the international level (UNEP 2004, p. 15). Defenders of Wildlife (2006) classify them into property rights innovations, market-oriented institutions, financial incentives and public tax incentives (Casey et al. 2006). Edem Kodzo (2012) focused in his classification on the principal market demand and supply and how the economic instruments affect the decrease or increase of biological resources. For example eco-labeling and certification are demand instruments because they can increase the demand for products from sustainably managed resource bases. Tax incentives for landowners to keep biological resources on their land are categorized in supply instruments.

The Mexican Ecology Law article 22 of LGEEPA (General Law on Ecological Balance and Environmental Protection for its acronym in Spanish) classified economic instruments as fiscal, financial or market based instruments (Cámara de Diputados del H. Congreso de la Unión 16.01.2014). The purpose of these instruments is to promote a change in people's behavior; to encourage the incorporation of information, to provide incentives to parties who perform actions for the protection, preservation or restoration and to ensure that those who would harm the environment bear the respective costs (article 21).

The IUCN (2008) classified economic instruments into market-based mechanisms and non market-based mechanisms (Table: IUCN Classification of Economic instruments for conservation). Payment for ecosystem services (PES) can be included in market based mechanisms, if there are direct payments to the landowners (Chomitz et al. 1999). In contrast to PES, conservation trust funds do not compensate directly the populations located in the area and do not establishing a price on the ecosystem services (Coronel 2011, p. 5). Due to this fact conservation trust funds can be classified as non – market-based mechanisms.

Table 4: IUCN Classification of Economic instruments for conservation

Economic Instruments	
Category	Example
Market-based mechanisms	· Markets for carbon sequestration
	· Markets for watershed services
	· Biodiversity offsets and mitigation
	· Conservation Banking
Non-market-based mechanisms	· Global environment facility
	· Debt-for-nature swaps
	· Conservation trust funds
	· Taxes

Table 4: Here are shown only some market and non-market based mechanism of the IUCN (2008). If there is determined a price on the ecosystem services, the economic instruments can be classified as market-based mechanism.

3.1.3 Non-market based mechanism: Conservation Trust Funds

The conservation finance alliance defines conservation trust funds (CTF) as private, legally independent grant-making institutions that provide sustainable financing for biodiversity conservation (CFA 2008). The funds are characterized as public-private partnerships aimed to raise and invest to make grants to non-governmental organizations (NGOs) and governmental agencies (GEF 1998). According to the Network of Environmental Funds in Latin America and the Caribbean (RedLAC), CTFs are fulfilling three main roles (Bath 2011):

1. Mobilize stable and predictable income to provide ongoing support (at least 15 years) for certain conservation activities in the country.
2. Do long term investment of the income to generate interest.
3. Provide funding for government operations, nonprofit organizations and / or community-based organizations, for the effective implementation of programs.

In addition to funding conservation projects, CTFs provide technical assistance and grants to strengthen the institutional capacity of grantees (CFA 2008). Meanwhile CTFs launched in the 90s were facing to generate grants for protected areas; the CTFs at present search to incorporate in its mission community development and poverty reduction. The funds invest in education and training projects, collaborate directly with government ministries to strengthen practices in

the natural resources management and manage income opportunities with the private sector (Bath 2011).

In 1998 the GEF grouped the CTFs into “park” funds and “grants” funds. Parks funds support specific protected areas within a national protected areas system and grants funds channel resources to target groups for a broad range of conservation and sustainable development projects (GEF 1998). A broader distinction was done by the conservation finance alliance (2008) to classify funds in endowment fund, green fund, brown fund, grants fund, parks funds, sinking funds and revolving fund (Table 5: Classification of conservation trust funds) (CFA 2008). This classification can be specified by differ between the objective and the financial resource management of the fund. Based on this distinction the water fund can be subordinate to the endowment fund (Figure 4: Conceptual framework for water fund). As seen in the FONAG water fund, the capital is invested in perpetuity, and only the resulting investment income is used to finance conservation projects (Herbert et al. 2010).

Table 5: **Classification of conservation trust funds**

Conservation Trust Funds	
Type	**Capital Management**
Endowment Fund	Capital is invested in perpetuity, and only the resulting investment income is used to finance grants and activities.
Sinking Fund	The entire principal and investment income is disbursed over a fairly long period (typically ten to 20 years) until it is completely spent and thus sinks to zero.
Revolving Fund	Income from taxes, fees, fines, or Payments for Ecosystem Services (PES), that are specially earmarked, regularly go into the fund to be used for specified purposes.
Type	**Objective**
Green Fund	Primarily finances activities related to biodiversity conservation.
Brown Fund	Finances activities such as pollution control and waste treatment. Many brown funds allocate five to ten percent of their grants for biodiversity conservation and PAs. Most brown funds are financed by pollution charges or fines
Grants Fund	Channels resources to target groups (typically CSOs) for a broad range of conservation and sustainable development projects, not limited to PAs
Parks Fund	Finances the management costs (and sometimes also the establishment costs) of specific PAs, or of a country‘s entire PA system. PA management costs can also include financing for alternative livelihoods or sustainable development activities in PA buffer zone communities.

Table 5: The classification of the conservation finance alliance (2008) does not include water funds. According to the FONAG, the capital management in water funds is similar to endowment fund with the objective to implement conservation measures in water recharge areas next to urban areas.

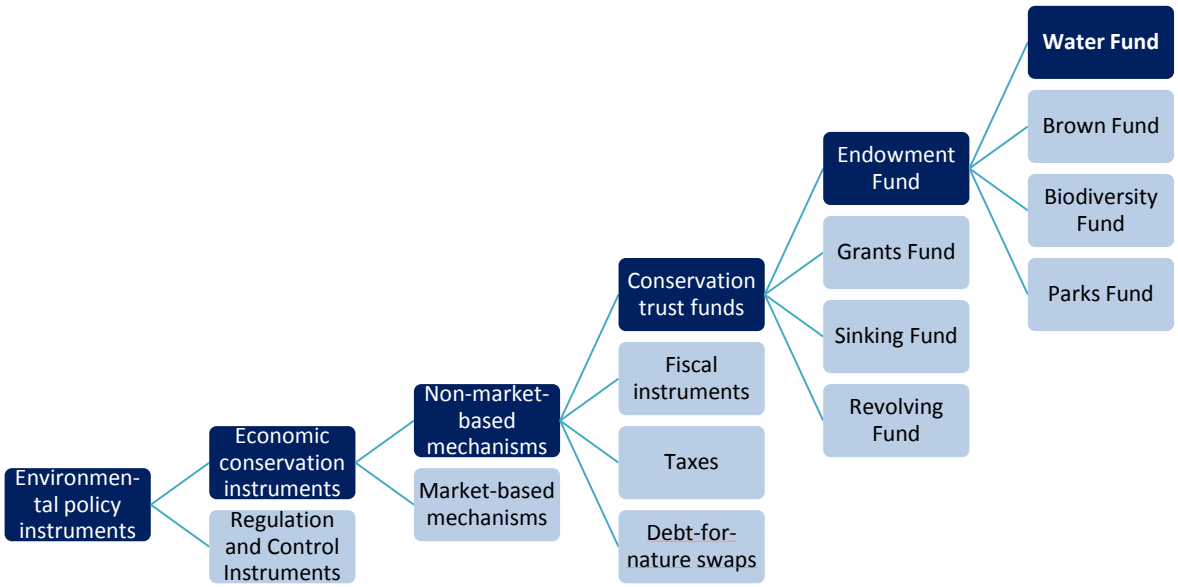


Figure 4: Conceptual framework for water funds

Based on this classifications water funds are adaptable and market independent economic conservation instruments that support and encourage long term conservation activities.

3.1.4 Water funds

Water funds are organized around the central principle of watershed conservation. The trust fund is capitalized by downstream water users who pool their money to finance upstream land management that ensures a clean (ie. sediment and pollutant free) water supply available year-round (Higgins and Zimmerling 2013, p. 4). Besides the conservation of water supply it can help to create shields to protect community and industrial facilities from floods. In some funds, the contributions are voluntary, while in others, funds come from legally required contributions. In consultation with technical advisors the stakeholders determine the allocation of conservation investments (Tallis and Markham 2012). The structure of the water fund can be analyzed by income, financial mechanism, institutional mechanism and investment of the fund.

3.1.4.1 Income

The water fund can be financed by public agencies (e.g. water utilities, hydropower companies); private companies (e.g. beer companies, bottled water companies); citizens (e.g. voluntary donations on their water bills, taxes); grants and private foundations; bi-lateral and multi-lateral donor agencies (e.g. USAID,

GIZ) or by financial returns generated from the trust fund or from other funds (GEF). The main contribution is generally done by a public agency (almost 50 % of the money) (Goldman et al. 2010, p. 7–8). Depending on the size of the area and the amount of participating stakeholders, the fund needs around 5 million USD to operate by its financial returns (Hesselbach, H., personal communication, 2014) The donations are put into a trust fund to generate interests or in the case of a smaller watershed the money can go directly to conservation activities (for example the Columbian water fund FONAPA) (Goldman et al. 2010, p. 7–8).

3.1.4.2 Financial mechanism

The management and administration of financial resources is one of the key elements of the water fund. Success depends largely on proper resource management and the independence of the legal and financial guarantees, and self-sustainability of financial resources (Calvache et al. 2012). There are several alternatives of entities for managing resources in a water fund. This could be a financial institution of purely private market or environmental funds created with the purpose of financing sustainable development projects. ALFA proposes four different types of water fund management: Creating a new trust fund; using an existing national environmental fund; creating a new organization or using a bank account (Calvache et al. 2012). All of the alternatives have pros and cons and it depends on the local condition to implement the most appropriate management scheme. A bank account for example represents low administrative costs and prevents the payment of management fees to a trust. In contrast to using an existing environmental fund, bank accounts give low technical and financial benefits (Goldman et al. 2010, p. 7–8).

3.1.4.3 Institutional mechanism

To succeed, water funds need more than financial management systems. They need governance structures, staff and technical support to enable them to proactively influence the environment in which they work (GEF 1998). The general guidelines of the funds should be the responsibility of a steering committee. This governing body of the fund is formed by representatives of different sectors. Ideally, the steering committee has a balance between the public sector and the private sector in order to ensure transparency and objectivity in making investment

decisions (Calvache et al. 2012). Based on the experience of the conservation trust fund alliance, the most critical factor for good governance is for a CTF to have a non-governmental majority on its board of directors (CFA 2008). The steering committee elects and approves a technical secretariat that then manages the water fund, calls meetings and works to implement decisions (Goldman et al. 2010, p. 7–8). The fund requires also a technical committee to provide necessary information and support investment alternatives from a technical point of view. The technical committee is a standing advisory body of the technical secretariat that offers scientific input for decision making (Calvache et al. 2012). The committee members are from the same organizations as the board of directors, but they are scientists and engineers. The number of staff varies significantly, depending on their financial resources, their geographical scope and their conservation strategies. However, the total number of paid staff ranges from around four as a minimum, to around 25 at large funds (CFA 2008 p. 35).

3.1.4.4 Investment

The water fund investments are generally focused on maintaining existing intact natural areas, protecting biodiversity, restoring lands throughout watersheds and along river corridors and implementing management practices to minimize the impacts of land use activities on water quality and quantity (Higgins and Zimmerling 2013, p. 4). In addition, funds are often used for alternative livelihood strategies and other social initiatives in participating rural communities, ranging from organic gardens to education projects, which help protect water supplies and improve the living and economic conditions for upstream communities (Higgins and Zimmerling 2013, p. 4). The overall obligation of the steering and the technical committees is to create and implement a strategic and an operational plan. These plans should include specific objectives and the types of activities and strategies used to achieve those objectives. For example the FONAG water fund developed the “Integrated Water Resources Plan of the Upper Guayllabamba River” to obtain the sustainable development of water resources in the long term in the region (Tucci 2009). To ensure that investments are having their anticipated impacts and to enable corrections to management strategies, Water Funds must include robust monitoring programs to track the environmental, economic, and social impacts of their actions. Due to limited funds and capacities, monitoring resources must be

targeted to capture the most relevant information. TNC published last year “a primer for monitoring water funds” that suggests monitoring parameters and explains key concepts and challenges in developing a Water Fund (Higgins and Zimmerling 2013, p. 5).

3.2 Theoretical framework

3.2.1 Key and influence area

The identification of key areas is the first step for designing, implementing and operating water funds (Calvache et al. 2012; Ortega-P et al. 2013) (Figure 5: Theoretical framework). The key areas are analyzed by conservation priorities, opportunities to finance conservation / restoration and stakeholders interested in maintaining ecosystem services. Beside key areas, ALFA use the concept influence areas and priority areas (Calvache et al. 2012). The area of influence of a water fund determines where specific conservation investments should be targeted to ensure ecological integrity and the provision of identified ecosystem services. The conservation priorities are defined based on the targets of the water fund (Calvache et al. 2012).

Other institutions, like WWF or the IUCN, use the concept of high conservation value areas (HCVAs), which are of outstanding significance or critical importance due to their high environmental, socioeconomic, biodiversity or landscape values (HCV Resource Network 2006). The High Conservation Value Resource Network classified six types of HCVA that are defined inter alia due to significant concentrations of biodiversity values (e.g. endemism, endangered species, refugee), located in or containing rare, threatened or endangered ecosystems, and for providing basic ecosystem services in critical situations (e.g. watershed protection, erosion control) (HCV Resource Network 2006).

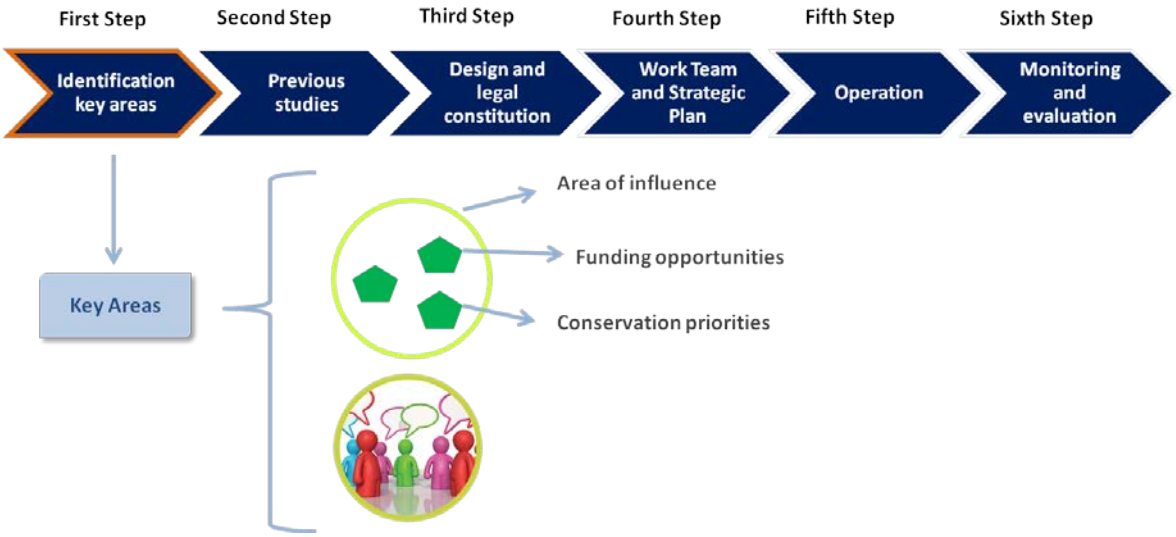


Figure 5: Theoretical framework to analyze the key areas.

The identification of the key areas is the first step to implement a water fund. The key areas are analyzed by the area of influence and the stakeholders' interest to participate in the water fund. The area of influence of the water fund could be defined by the limits of the watershed or the political division and is analyzed by conservation priorities and funding opportunities

3.2.2 Identification of conservation priorities

According to ALFA, in some cases, negotiation between stakeholders will guide where initial investments are made and where future priority areas are. A diagnostic screening or modeling exercise can be also used to identify the conservation priorities. There are several technical tools like the Integrated Valuation of Ecosystem Services and Trade-offs Tool (InVEST) or the Soil and Water Assessment Tool (SWAT) that can select the areas that will likely have the largest returns for each possible activity in each area (investment areas) (P - Ortega et al. 2013). However, it is complicated to obtain all of the data needed to run the models. The InVEST tool for example requires specific data to calculate rainfall erosivity, soil erodibility, sediment retention or riparian continuity (Tallis et al. 2013).

Based on the agreements of the Protected Areas Programme of the Seventh Conference of the Parties (COP-7), held in Kuala Lumpur in 2004, CONANP and CONABIO in collaboration with numerous institutions and specialists formed a working group to identify priority sites (conservation gaps) for biodiversity conservation in Mexico. The study focused on analyzing ecological landscapes

underrepresented in PAs; areas of high biological richness; areas of highest concentration of endemic species and sites of outstanding conservation value that are not currently protected and that require conservation to maintain a representative part of Mexico's biodiversity. The sites are classified by medium, high and extreme priority for conservation (CONABIO et al. 2007).

3.2.3 Stakeholders

In the last 20 years the word ’stakeholder' has become important in public and nonprofit management theory and practice (Bryson 2004). In 1984 Freeman defined stakeholders as 'any group or individual who can affect or is affected by the achievement of the organization's objectives' (Freeman 1984). During the years there have been developed several definitions of stakeholder which differ in who and what counts (Bryson 2004). In the conservation context WWF defined stakeholders as people, institutions, or social groups that are involved in, or affected by, decision making regarding biodiversity conservation issues (Golder et al. 2005, p. 3). For the present study, stakeholders are defined as any individual, group, or institution that is present in or related to the key area or will have a direct or indirect relationship with the water fund planned.

Once the stakeholders are defined it requires a stakeholder analysis that identifies and groups the stakeholder. The goal of stakeholder analysis is to develop a strategic view of the human and institutional landscape, and the relationships between the different stakeholders and the issues they care about most (Golder et al. 2005, p. 3). For this master thesis the stakeholder analysis will help to identify the interests of the stakeholders who may affect or be affected by the water fund; to identify groups that should be encouraged to participate in different stages of the water fund; and to analyze the opportunities or risk that may arise from the stakeholder’s participation. The classification can be done by sectors and organized by level of interest and level of influence in the key area.

4 Methodology

4.1 Influence area

The conservation priorities and funding opportunities for the water fund are identified by four categories: high biological significance, vulnerability to anthropogenic activities, aptness for reforestation and soil erosion control projects and special land tenure properties. The subdivision in these four categories permits their inclusion of previously identified conservation priorities of CONANP and CONABIO and conservation funding programs of CONAFOR. This facilitates to incorporate the different hydrological, biological, social and economical indicators that have been taken already into account in previous selection processes.

The methodology to analyze the funding opportunities and conservation priorities in the influence area of the water fund consists on a geographical analysis under established criteria (Table 6: Analysis of the influence area). The selection of the criteria for the analysis is based on two programs: “The identification of eligible areas (priority areas), and defining areas of differentiated payment of ecosystem services” of the National Forest Commission that include social, hydrological and biodiversity indicators (CONAFOR 2012b, p. 1) and, the “satellite monitoring program to control eroded soil due to the loss of vegetation cover and urbanization process” of the state of Mexico (EDOMEX 2009b). The analysis of CONAFOR and EDOMEX were adjusted to the available information given on the study area and complemented by opinions of Edith Caballero (Director of project in west center region, Pronatura Mexico) and Eduardo Cota (Director of Conservation and Restoration of Ecosystems, Pronatura Mexico) (Cota, E., personal communication, 2014; Caballero, E., personal communication, 2014). Finally, several criteria were joined to identify high priority areas for the water fund (Table 7: Filters to identify the high priority areas).

Table 6: Analysis of the influence area

Category	Analysis	Explanation	Indicators	GIS Data Source
Areas with special arrangements	Protected Areas	In Mexico according with the administration criteria, there are federal, state, municipal, community protected areas and according with land tenure can be community ejidal and private (CONABIO 2014). Federal protected areas are created by presidential decree and conservation, restoration or development activities can be implemented on them according to the General Law of Ecological Balance and Environmental Protection, Regulations (LGEEPA), management plans and Ecological Regulation Studies (EDOMEX 2009b). Protected areas with biodiversity and ecological characteristics of particular relevance to the country form part of the National System of Protected Areas (SINAPs) (Bezaury-Creel and Gutiérrez 2009, p. 398).	Number and type of PA; existing management plans and staff; PA that are part of SINAPs	CONANP 2010
	Land tenure	The constitution established three different forms of land tenure in Mexico: private, public, and social. Social property was further subdivided into communal and ejido lands (USAID 2011). It is estimated that about 70% of terrestrial biodiversity of the country lies in the hands of ejidos, communities and smallholders. Even within the same protected areas, 60% are social property, at least 20% are publicly owned and about 12% belong to private property (Bezaury-Creel and Gutiérrez 2009, p. 398).	Areas with private and public property	RAN 2005
Areas subject to restauration	Payment for Ecosystem Services (PES) program	The PES is a Federal Government strategy with the objectives to improve the provision of environmental services (such as water recharge and carbon sequestration) and to create economic incentive for the land owners on which these environmental services are generated. Depending on the location, CONAFOR provides six different payment amounts according to the vegetation cover and the “Deforestation Risk Index” (IRDef) classified by INECC, in the polygon area of the applicant (Graf Montero 2012).	Eligible zone of the CONAFOR PES program of 2014; level of payment area (1 - 6)	CONAFOR 2014

	Forest Restoration Program in Priority Watersheds	The objective of the program is to implement conservation measures in priority watershed areas to mitigate the effects of climate change, restore vegetation, prevent soil erosion, promote infiltration and improve water quality and supply, and to capture carbon dioxide (CO_2) (CONAFOR 2013).	Municipalities that belong to the Forest restoration program	CONAFOR 2014
Areas of biological significance	GAP Analysis	Based on the agreements of Protected Areas Programme of the Seventh Conference of the Parties (COP-7), held in Kuala Lumpur in 2004, the CONANP and CONABIO in collaboration with numerous institutions and specialists formed a working group to identify priority sites (conservation gaps) for biodiversity conservation in Mexico. The study focused on analysing ecological landscapes underrepresented in PAs; areas of high biological richness; areas of highest concentration of endemic species and sites of outstanding conservation value that are not currently protected and that require conservation to maintain a representative part of Mexico's biodiversity. The sites were classified by medium, high and extreme priority for conservation (GAP 2007).	Sites classified by medium, high and extreme priority for conservation.	CONABIO CONANP, 2007
	IBAs	The IBAs are areas of importance for bird conservation. IBAs are a tool for decision-making sectors to help standardize criteria for prioritization and resource allocation for conservation. Each area contains a technical description that includes biotic and abiotic information, a list containing the avifauna recorded in the area, their abundance (as categories) and seasonality in the area.	Existence of IBAs in the area	CONABIO 2002
	Threatened species	In Mexico four categories are used to classify species at risk (listed in NOM-059-2010 (SEMARNAT 30.12.2010) **Probably extinct in the wild**: Native Mexican species whose specimens have disappeared in the wild within the country and has known the existence of living specimens outside of Mexico. **Endangered:** Species whose ranges or population size have declined dramatically due to factors such as destruction or drastic habitat modification, unsustainable harvesting,	Species at risk listed at the NOM-059 (SEMARNAT 30.12.2010)	CONABIO 2010

		disease or predation, among others; threatening its biological viability throughout their natural habitat. **Threatened:** Species that could potentially be in danger of disappearing in the short or medium term, if the factors that adversely affect their viability continue to operate. **Subject to special protection:** Species or populations that could potentially be threatened by factors that adversely affect their viability. This condition requires their recovery and preservation or restoration and conservation of stocks of associated species (classification of SEMARNAT is used from the IUCN Red List).		
Areas highly vulnerable to anthropogenic actions	Urbanization	The land use change caused by urban development endangers many environmental services. The expansion of urban areas cause severe environmental problems such as air, water and soil pollution, overexploitation of the aquifers and the disappearance of several ecosystems and vegetation types (Pisanty et al. 2009, p. 720).	Urban expansion	INEGI 2010
	Fragmentation by highways	Fragmentation occurs when a large, continuous habitat is reduced and divided into two or more fragments. The fragmentation trigged by roads threatens the persistence of the species by the barrier effect and the edge effect (Arroyave 2006).	Fragmented areas, type of road	INEGI 2010
	Soil degradation	As part of the National Forestry and Soil Inventory, a study was conducted to evaluate the degradation caused by humans. The degradation process was analyzed by the level of soil degradation (mild, moderate, severe, and extreme), type of soil degradation processes (chemical, physical) and erosion process (wind, water) and the factors for soil degradation (urbanization, overgrazing, deforestation, overexploitation of vegetation, agriculture) (SEMARNAT 2013, p. 108).	Type of soil degradation; factors for soil degradation	SEMARNAT 2004

Table 7: Filters to identify the high priority areas

	Indicator	Selection
1st filter	GAP	Sites classified by high and extreme priority for conservation
2nd filter	IBA	Sites located in the IBA
3rd filter	Irregular settlements	Municipalities with growth of irregular settlements
4th filter	High basin	Sites located in the high basin (2600m – 3600 m)
5th filter	Priority Watershed areas	Areas identified as priority watershed for COANFOR
6th filter	Protected Areas	Areas that are not under special protection
7th filter	Fragmentation	Larger contiguous areas without fragmentation caused by roads

Table 7: Every filter means the addition of a new map and a reduction of the area of influence. The identified high priority areas include all seven filters.

4.2 Stakeholder analysis

4.2.1 Identification of the stakeholders

According to the methodology of the International Centre for Development Oriented Research in Agriculture (ICRA), the first step of the analysis consists in listing all the persons, groups and organizations who are potential stakeholders (ICRA n.d.). The identification process requires the review of studies on water and conservation management in the study area; an analysis of organizations supporting the initiative of the water forest and personal interviews. The persons were selected for the interviews by its participation in other water funds, experience in the influence area, the importance of organization and to high accessibility due to previous professional relations.

After the identification process the stakeholders have to be differentiated and grouped. It is important to identify clusters of stakeholders that might be grouped as one because they pool resources or responsibilities together (Groot, n.d. p. 5). The stakeholder classification is based on the methodology of TNC to group the organizations by sectors (Table 8: Stakeholder classification; Calvache et al. 2012).

Table 8: Stakeholder classification

Sector	Stakeholder
Public	Water company, local government
	Power generation company
	National Environmental Authority
	Local environmental authority
	Water Authority
	Research Institutes
	Irrigation Districts
Private	Water Company
Academic	Research centres
	Universities
Civil society	Associations of water boards.
	CSO
International cooperation	Multilateral cooperation
	Government Agencies

Table 8**:** The classification of TNC was adapted to the conditions of the influence area. In the private sector there have been excluded several subcategories. Source (Calvache et al. 2012).

4.2.2 Stakeholder influence and interest

Once the relevant stakeholders are identified and grouped, the next step consists in identifying those stakeholders who are interested in the implementation of a water fund in the study area and those who can influence (negatively or positively) the implementation process.

Influence refers to the power stakeholders have over the water fund to control which decisions are made, facilitate its implementation or exert influence that affects the development of the water fund negatively. According to ICRA, influence is in fact the extent to which a stakeholder is able to persuade or coerce others into decision-making and/or implementation of actions (Groot n.d., p. 5).

Interest refers to the stakeholder's priority (satisfies needs and interests) given by the implementation of the water fund in the study area. Some stakeholders can have a high interest in the creation of a water fund but have a very limited power to influence key decisions (Calvache et al. 2012).

The analysis process of stakeholder´s influence and interest requires reviewing the legal framework including laws, regulations, plans and programs on water, land management, protected areas and forest conservation of the study area. Furthermore, interviews are carried out with key organizations from different sectors to get detailed information about their interest to participate in the water fund. The obtained information will be analyzed by:

Table 9: Indicators to determine the interest and influence of the stakeholders

Key areas	Indicators
Influence	Administrative or legal hierarchy (on water resources, influence area, financial resources)
	Authority of leadership (political)
	Control of strategic resources for the project (data source)
	Negotiation position (strength in relation to other stakeholders in the project)
Interest	Conservation projects in the influence area
	Dependency of the ecosystem services of the influence area
	Participation in the Initiative of the Water Forest
	Support of other water funds in Latin-American

Source: ICRA n.d.

Finally, to sum up the results of the analysis; the methodology of Eden and Ackermann (Eden and Ackermann 1998: 121 – 5, 344-6) propose a two by two matrix of high and low importance and influence (Figure 6: Stakeholder matrix). Within each cell of the matrix stakeholders can be placed in upper or lower halves to further suggest relative positioning (Groot, n.d. p. 5). The results of identifying the position of the various stakeholders will be used to analyze how every stakeholder group should participate in the water fund and in which moment. The organizations that belong to the cell with high influence and high interest are the key stakeholders for the participation in the water fund.

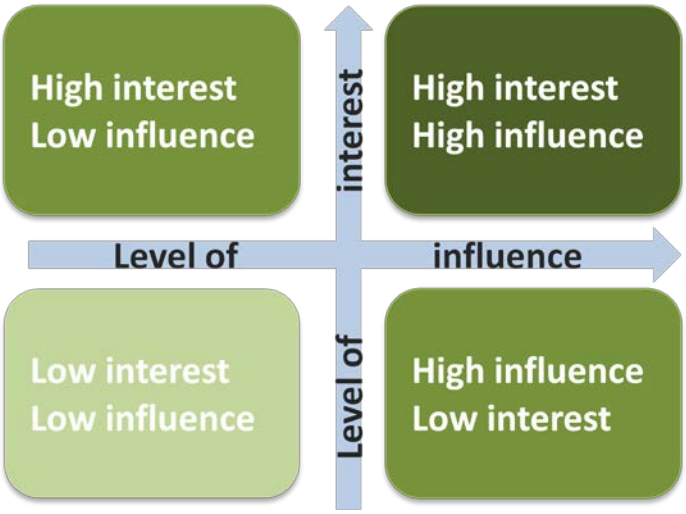


Figure 6: Stakeholder matrix

The stakeholder matrix offers a visual resume of the stakeholder classification. Depending on the position of the stakeholder differs the participation in the water fund. Source: Eden and Ackermann (Eden and Ackermann 1998).

5 Analysis

5.1 Area of influence

5.1.1 General description of the influence area

The section of the Water Forest that belongs to the watershed of the Mexican Valley includes part of Mexico City and part of the state of Mexico (Figure 7: Zoning of the influence area), comprising an area of 893 km². There are 16 municipalities that belong to the influence area. Jitzoltingo (120 km²), Huixquilucan (112 km²) and Milpa Alta (101 km²) are among the largest municipalities. Most municipalities (eight municipalities) are governed by the electoral alliance "Commitment Mexico" formed by the governmental Institutional Revolutionary Party (PRI), the Green Ecologist Party of Mexico (PVEM) and the New Alliance Party (PNA). All five municipalities of the federal district are governed by the Party of the Democratic Revolution (PRD) and only one municipality “Atizapán de Zaragoza” is governed by the former ruling party, the National Action Party (PAN) (Table 10: Political parties).

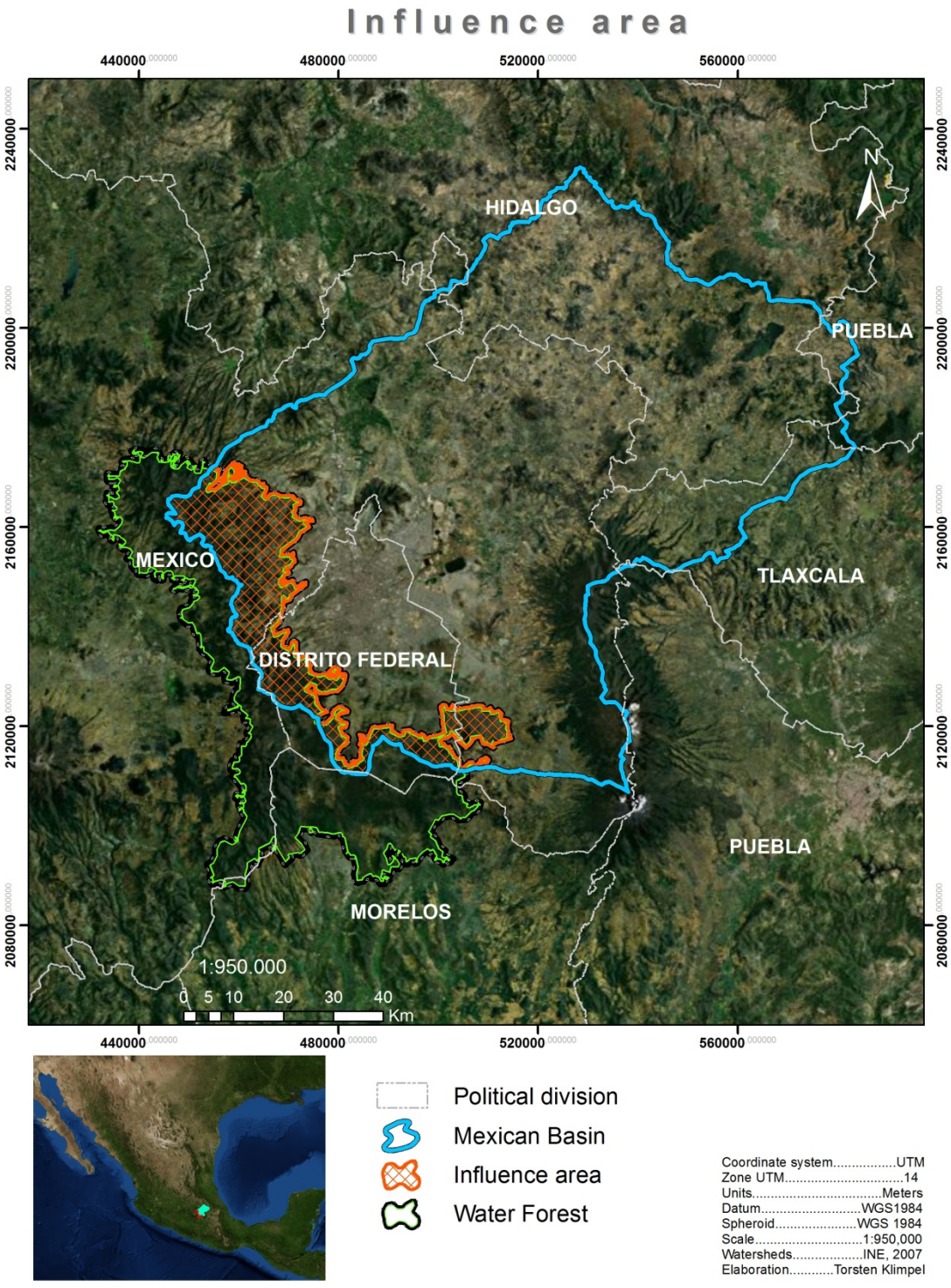


Figure 7: Zoning of the influence area.

The initiative of the Water Forest and the initiative of ALFA to implement a water fund in the watershed of Mexican Valley were linked by their common interest to protect part of the recharge area of the Mexican basin.

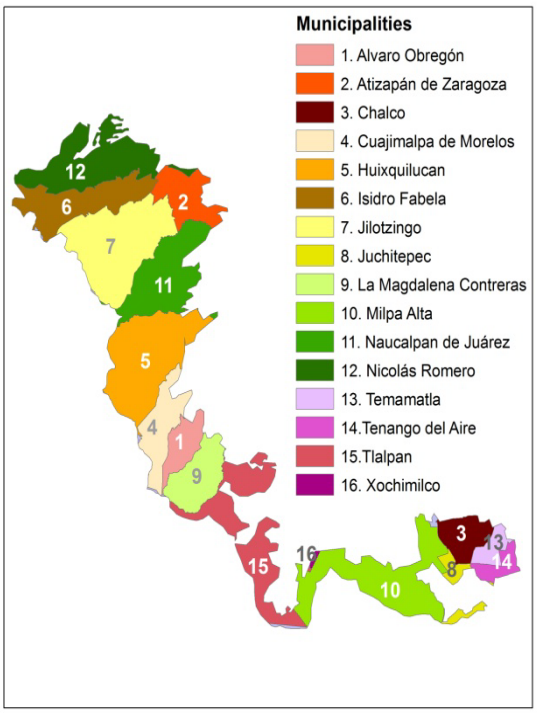


Figure 8: Municipalities located in the influence area.

Based on INEGI 2005

Table 10: Political parties

State	Municipalities	Political Party 2
Federal District	Alvaro Obregón	PRD
State of Mexico	Atizapán de Zaragoza	PAN
State of Mexico	Chalco	PRI-PVEM-PNA
State of Mexico	Cuajimalpa de Morelos	PRI
State of Mexico	Huixquilucan	PRI-PVEM-PNA
State of Mexico	Isidro Fabela	PRI-PVEM-PNA
State of Mexico	Jilotzingo	PRI-PVEM-PNA
State of Mexico	Juchitepec	PRI
Federal District	La Magdalena Contreras	PRD
Federal District	Milpa Alta	PRD
State of Mexico	Naucalpan de Juárez	PRI-PVEM-PNA
State of Mexico	Nicolás Romero	PRI-PVEM-PNA
State of Mexico	Otzolotepec	PRI-PVEM-PNA
State of Mexico	Temamatla	MRA (PT-MC)
State of Mexico	Tenango del Aire	PRI-PVEM-PNA
Federal District	Tlalpan	PRD
Federal District	Xochimilco	PRD

Table 10: Political parties**.** Several political parties are present in the area of influence, which makes it difficult to find a consensus in a common conservation policy. INAFED 2014

[2] PRI = Partido Revolucionario Institucional, PAN = Partido Acción Nacional, PRD = Partido de la Revolución Democrática, PRD = Partido de la Revolución Democrática, PNA= Partido Nueva Alianza, PVEM = Partido Verde Ecologista de México, PT= Partido del Trabajo, MC= Movimiento Ciudadano

5.1.2 Areas with special arrangements

5.1.2.1 Protected areas

In the study area there are seven state level PAs, two federal level PAs and two community reserves (Table 11: Protection level). The largest PA, Lagunas de Zempoala, has a total size of 4,790 ha and is the only PA registered in the National System of Protected Areas (SINAP)[3]. Only two PAs have management plans and most of the protected areas are missing assigned staff (Table 11: Protection Level).

Table 11: Protection Level

State	Name	Admini-stration	Category	SINAP[4]	Manage-ment Plan	Assigned staff
State of Mexico	Atizapan - Valle Escondido	State level	Public nature recreation park	No	n.a.	n.a.
Federal District	Ecoguardas	State level	Ecological conservation area	No	No	Advisory Council[5]
State of Mexico	Espiritu Santo (Cerro Chiuca)	State level	Ecological conservation area	No	n.a.	n.a.
Federal District	Parque Ecológico de la Ciudad de México	State level	Ecological conservation area	No	No	n.a.
Federal District	San Miuguel Topilejo	State level	Community ecological reserve	No	No	In process[6]
Federal District	San Nicolas Totolopan	State level	Community ecological reserve	No	No	n.a.

[3] Those areas that are of particular relevance in some of the following characteristic are included in the SINAP: species richness; presence of endemism; presence of species of restricted distribution; presence of species at risk; species difference with regard to other protected areas previously incorporated into the SINAP; presence of ecosystem diversity; presence of relict ecosystems; Presence of ecosystem with restricted distribution; presence of important natural phenomena; functional integrity of ecosystems; importance of environmental services generated, and social viability for preservation (CONANP 2012)

[4] CONANP 2012

[5] Advisory councils that support and advise on the management and administration of the PA

[6] In process of establishing an advisory councils

State of Mexico	Zempoala - La Bufa	State level	Recreation tourist eco park	SINAP - 032	1	n.a.
State of Mexico	Desierto de Los Leones	Federal level	Federal level protected area	No	1	In process
State of Mexico	Cumbre de ajusco	Federal level	Federal level protected area	No	No	n.a.
Federal District	Milpa alta	Community	Community Reserve	No	n.a.	n.a.
Federal District	San Bernabe	Community	Community Reserve	No	0	In process

Based on CONANP 2010, CONANP 2012, Hoth 2012, (SEDEMA 2013)

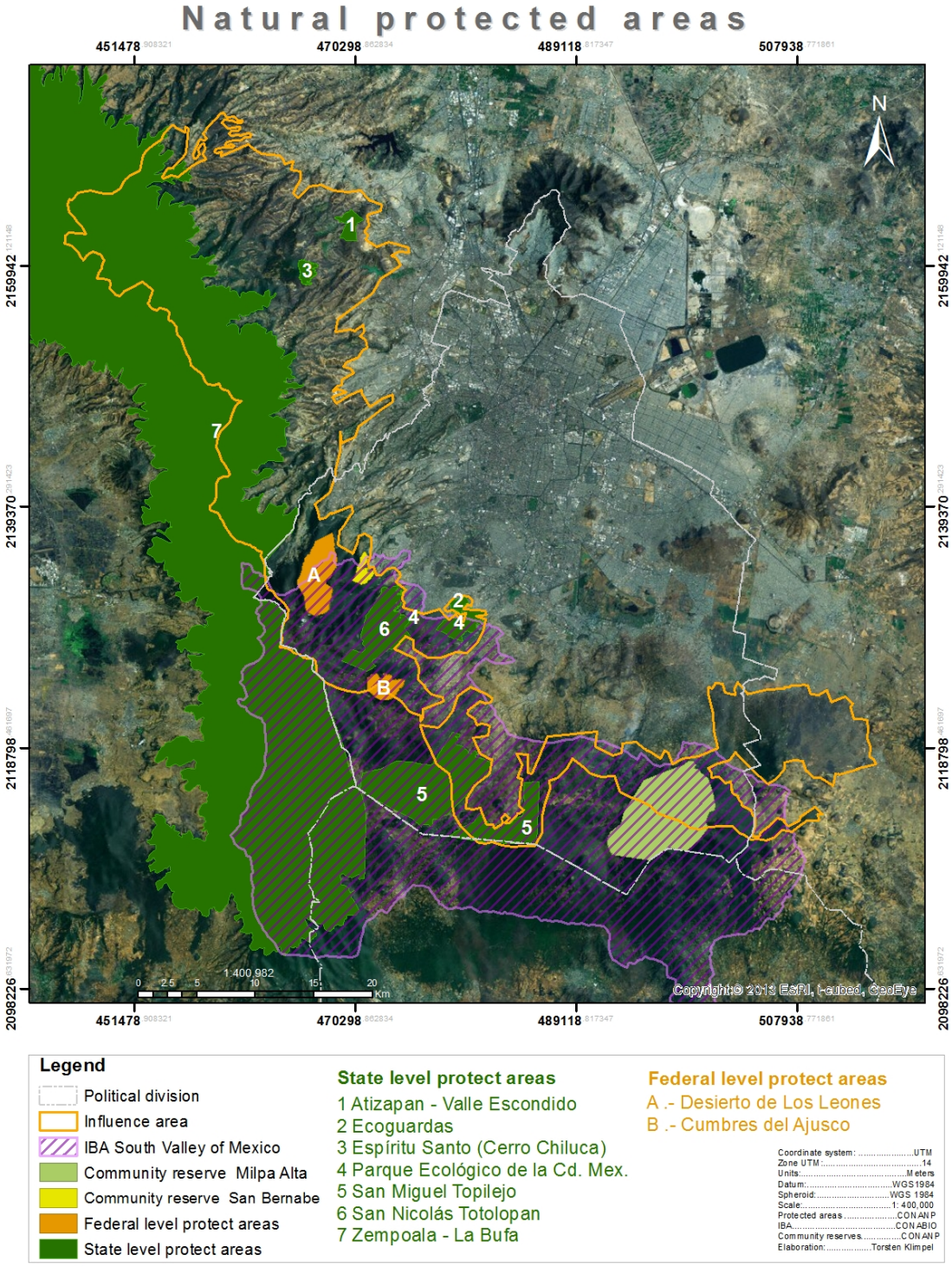


Figure 9 : Natural protected areas.

Most of the protected areas are located in the Federal District. The largest protected area covers half of the influence area of the state of Mexico.

5.1.2.2 Land tenure

The land tenure of the study area is divided by the states. Meanwhile community landowning is predominant in the federal district; the ejido is the common landowning in the state of Mexico (Figure 10: Land tenure). This distribution is also reflected in the category of the PA. Both community reserves (Milpa Alta and San Bernabé) as well as the state level protected areas categorized as “Community ecological reserve” (San Nicolás Totolopan and San Miguel Topilejo) are located in the federal district. In the Chalco, Tenango del Aire and Temamatla municipalities, located in the south east of the study area, there are private property, small property and federal zone present.

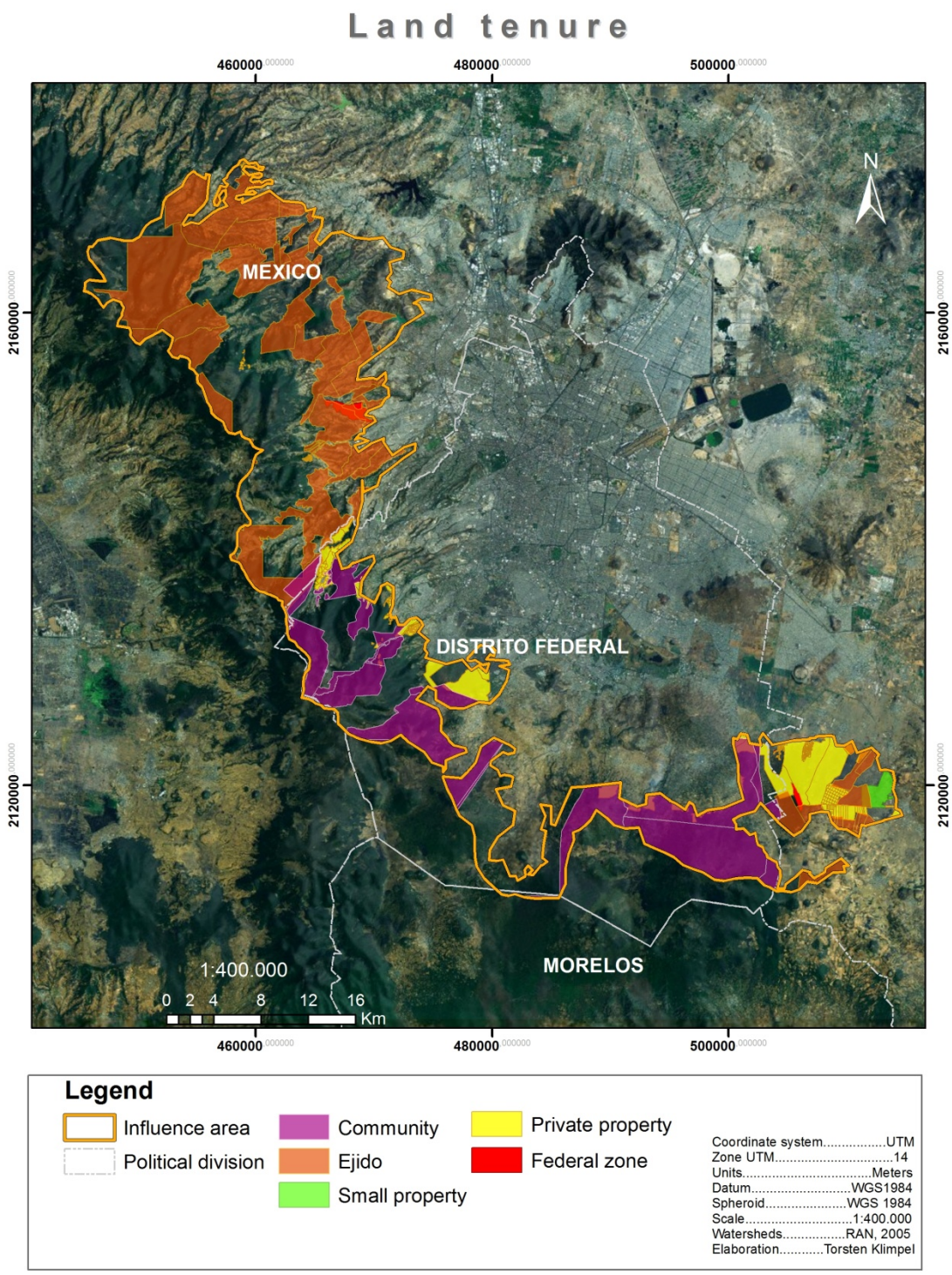


Figure 10: Land tenure.

Similarly as in all of Mexico, most of the land in the study area is social property (community and ejidos). The reasons for the free surfaces are missing data in this area.

5.1.3 Areas of biological significance

5.1.3.1 GAP Analysis

Gap analysis is, in a conservation context, a method to identify biodiversity (species, biotic communities, ecosystems and ecological processes) not adequately conserved within a protected area network or through other effective and long-term conservation measures (Dudley 2005, p. 14). Most of the study area was classified in 2007 as high priority areas due to the high biological richness; the concentration of endemic species and sites of outstanding conservation value that are not currently protected (Figure 11: GAP analysis). Even one site, located in the municipalities of Huixquilucan and Cuajimalpa de Morelos, was classified as extreme priority. As a response to the extreme priority, the community ecological reserve San Bernabé Ocotepec was decreed in June 21, 2010 (Gobierno del Distrito Federal 21.10.2010). Two other PAs “Desierto de los Leones” and “San Nicolás Totolopan” already existed in this extreme priority area, but with low success. According to the management plan of the PA “Desierto de los Leones”, several problems are present like pollution from urban areas; lack of management of forest vegetation which causes the presence of an old tree population without regeneration; presence of forest fires; disordered water extractiion in the upper parts; lack of attention to erosion; introduction of plant species not suitable for the area and lack of definition of legal process regarding land tenure (CONANP 2004).

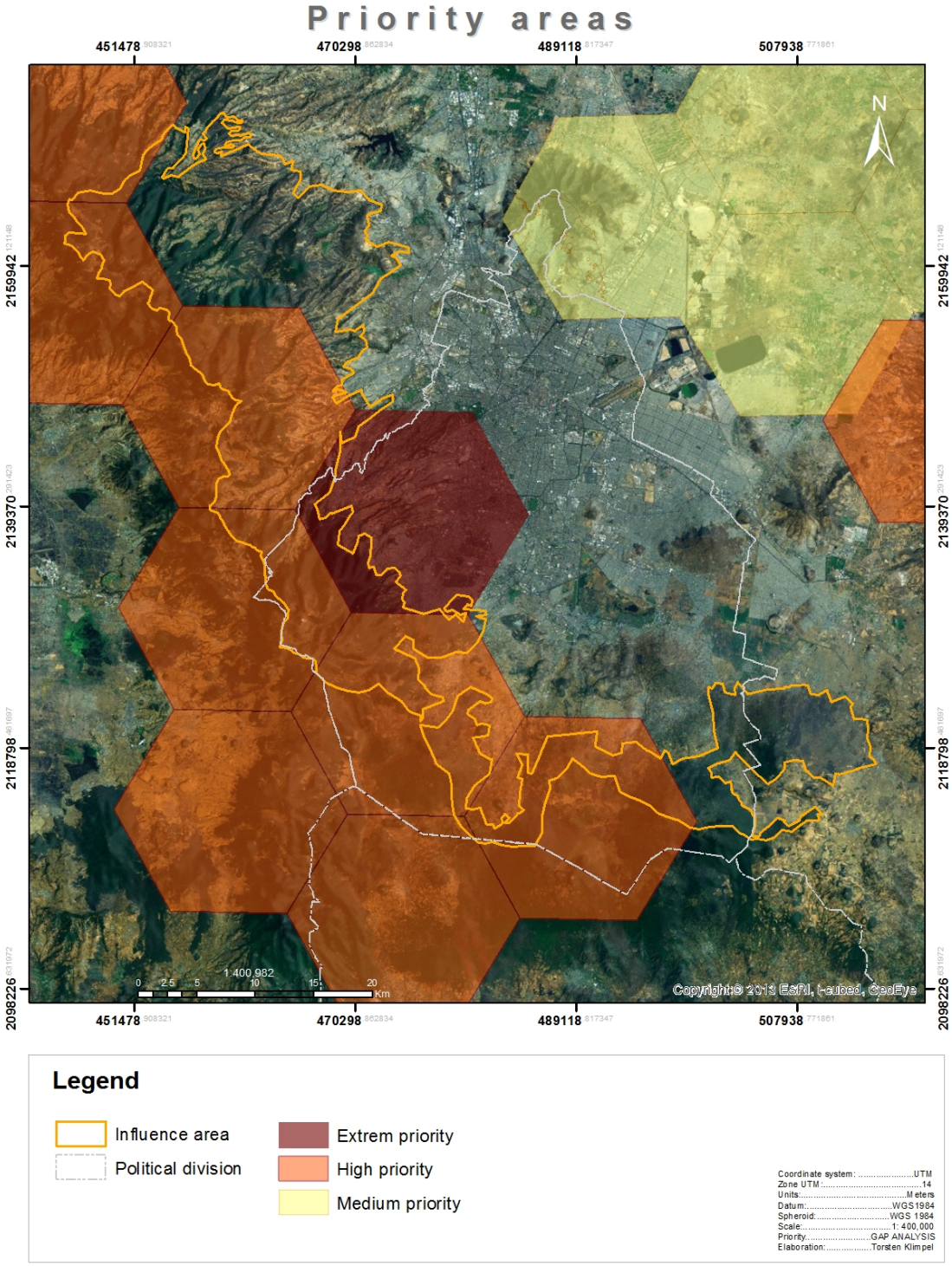


Figure 11: GAP analysis.

Most of the study area was classified in 2007 as high priority areas. It is interesting that in the north of the influence area, there is no priority area although it exposure to high urbanization (Figure 18: Urban pressure)

5.1.3.2 Important Bird Areas

Important Bird Areas (IBAs) are sites needed to ensure the survival of viable populations of most of the world's bird species and to hold a large and representative proportion of other biodiversity (BirdLife 2014). The IBA concept was started by Birdlife in 1980 and Pronatura Mexico is its Mexican affiliate. There are four different criteria used in the designation of IBAs (Table 12: Indicator for Important Bird Areas). The IBA located in the study area "IBA Nr. 14 of the south of Mexican Valley" with a total size of 100,153 ha has been designated based on criteria A1, A2 and A3 (Table 12: Indicator for Important Bird Areas). It is estimated that the IBA Nr. 14 maintains the existence of approximately 200 species of birds (20 endemic) (AVESMX 2007).

Table 12: Indicator for Important Bird Areas

Indicator	Explication
A1.Globally threatened species	The site is known or thought regularly to hold significant numbers of a globally threatened species, or other species of global conservation concern.
A2. Restricted-range species	The site is known or thought to hold a significant component of a group of species whose breeding distributions define an Endemic Bird Area (EBA) or Secondary Area (SA).
A3. Biome-restricted species	The site is known or thought to hold a significant component of the group of species whose distributions are largely or wholly confined to one biome.
A4. Congregations	i). Site known or thought to hold, on a regular basis, 1% of a biogeographic population of a congregatory waterbird species.
	ii). Site known or thought to hold, on a regular basis, 1% of the global population of a congregatory seabird or terrestrial species.
	iii). Site known or thought to hold, on a regular basis, 20,000 waterbirds or 10,000 pairs of seabirds of one or more species.
	iv). Site known or thought to exceed thresholds set for migratory species at bottleneck sites.

Source: (BirdLife 2014)

5.1.3.3 Land use and vegetation cover

Currently the vegetation cover in the forest is a mosaic of vegetation types that prevail in the pine forest (*Pinus,* spp.), oak forest (*Quercus* spp.), oyamel forest (*Abies* spp.) and grasslands. Secondary vegetation is mainly located in the south of the study area in pine and oak forest sites, which have been disturbed (Figure 12: Land use and vegetation cover). Most of the crop production is practiced in the state of Mexico, largely dominated by the cultivation of maize (Zea mays) and then

bean (Phaseolus vulgaris), barley (Hordeum vulgare), oats (Avena sativa) and potatoes (Solanum tuberosum) (EDOMEX 2009a) and the agriculture in Milpa Alta is mainly production of nopalito (young cladodes of Opuntia ficus-indica).

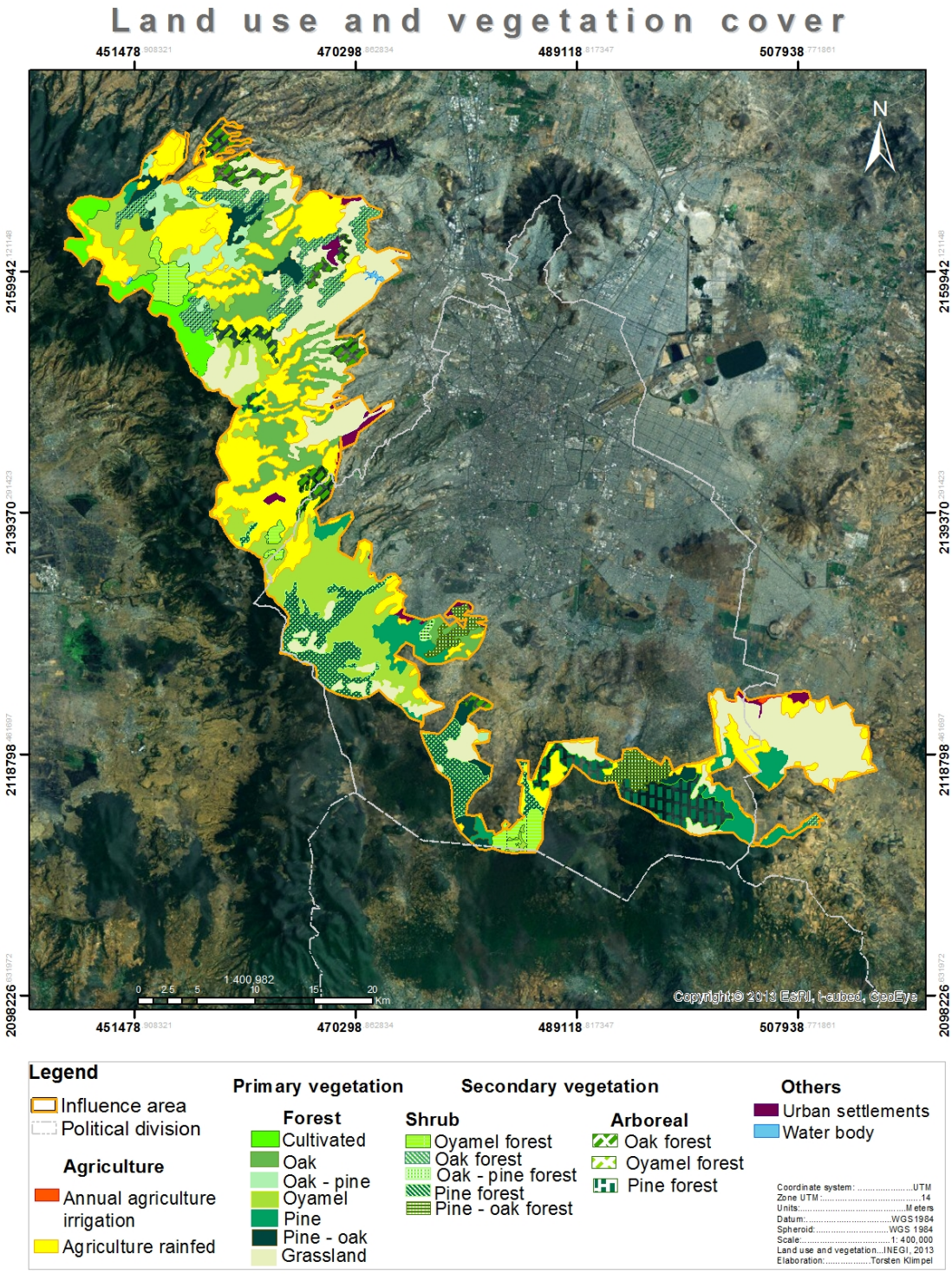


Figure 12: Land use and vegetation cover.

Most of the agriculture is located in the influence area that belongs to the state of Mexico. Large pine oak areas are mainly in the north of the municipality Milpa Alta.

5.1.3.4 Threatened species

Most of the threatened species are located in the forests and canyons of Cuajimalpa, in Alvaro Obregon and La Magdalena Contreras, as well as in the highlands with forested areas, in Tlalpan and Milpa Alta delegation (Figure 15: Threatened species and (SEDEMA 2013). The two endangered species which have been found in the study area the bird *Xenospiza baileyi (*Bailey's sparrow or gorrión zacatero serrano) and lagomorph mammal species *Romerolagus diazi* (volcano rabbit, teporingo or zacatuche), appear mainly in the Tlapan delegation including a buffer of 10 km. *Romerolagus diazi* (Figure 14: *Romerolagus diazi*) is threatened by habitat loss caused by livestock grazing, agriculture and property development encroachment, harvest of the “zacaton” grasses (*Muhlenbergia* sp.), and forest fire, as well as habitat fragmentation by highway construction (Romero Malpica and Rangel Cordero 2008). The bird *Xenospiza baileyi* is classified as endangered owing to its extremely small range, which occurs at just two locations. One location is around La Cima and Milpa Alta, where there are perhaps 5,380-6,150 adults equal to 2,300 breeding pairs (BirdLife International 2012) (Figure 13: *Xenospiza baileyi*). Several bats (*Leptonycteris nivalis, Leptonycteris curasoae and Choeronycteris mexicana)* and mice (*Reithrodontomys microdon* and *Dipodomys phillipsii)* are classified as threatened as well as species under special protection *(*the mouse *Dipodomys phillipsii phillipsii* and the tree *Acer negundo mexicanum)* (Figure 15: Threatened species).

Figure 13: *Xenospiza baileyi*
Source: IBA 2012

Figure 14: *Romerolagus diazi*
Source IBA 2012

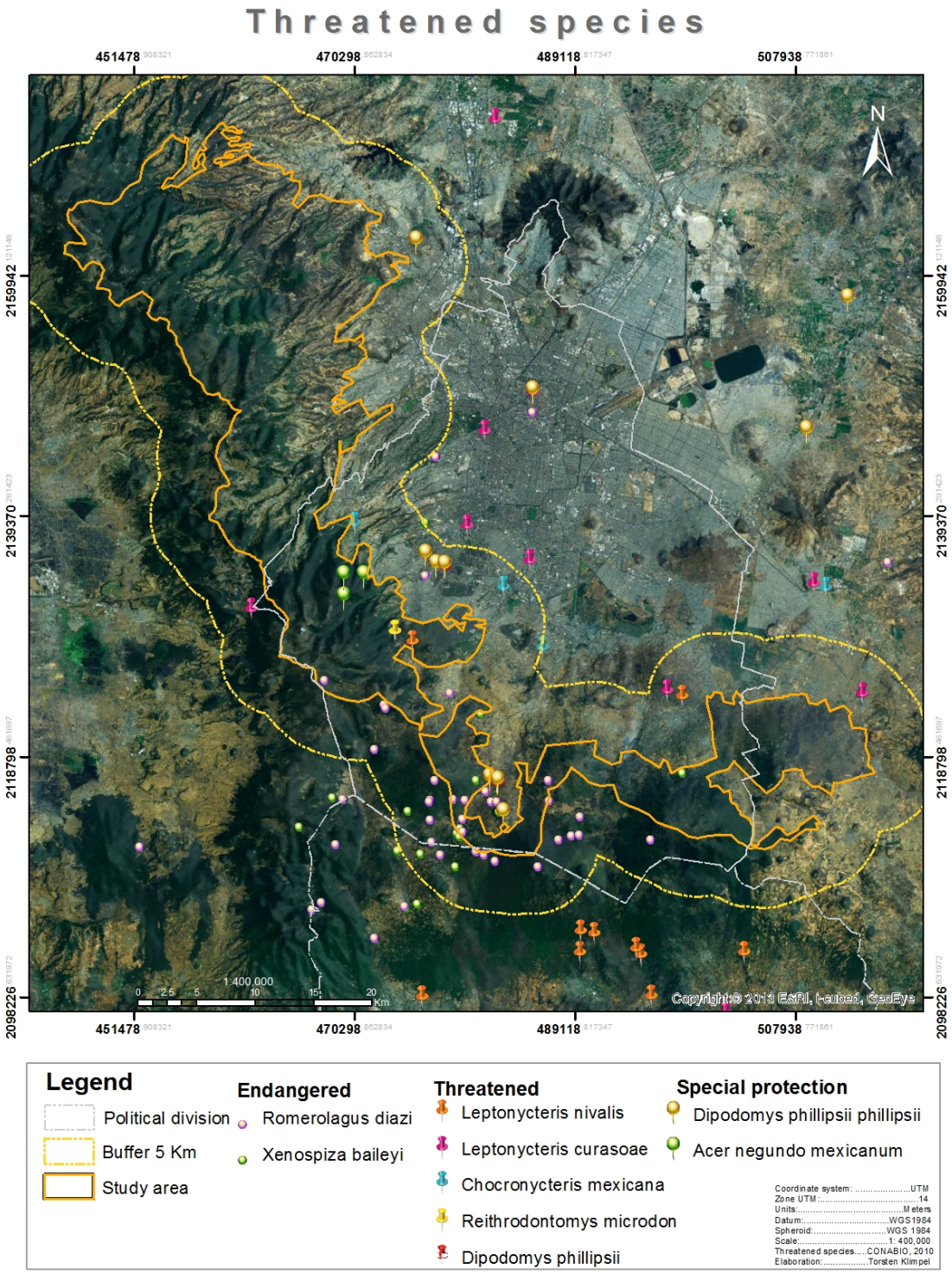


Figure 15: Threatened species

The figure shows the threatened species of the influence area within a 5 km buffer.

5.1.4 Areas subject to restoration

5.1.4.1 Differentiated Payments of Ecosystem Services (PES)

The PES program seeks to establish institutional arrangements (agreements) that allow users to transfer resources to providers of environmental services to promote land management that will maintain and improve the provision of ecosystem services of interest. Differentiated payments are established for 1 to 5 years and establish obligations on landowners such as limitations on extensive grazing, maintain site monitoring, protection against fire, prevention of degradation, signaling the area subject to the PES, avoid land use changes of forest cover and conserve the vegetation (Graf Montero 2012). As most of the sites within the study area comply with the third category established by the Ecosystem and Deforestation Risk Index (Figure 16: Differentiated Payments for Ecosystem Services), landowners have the possibility to receive payments amounting to $38 USD (Table 13: Payments according to the Ecosystem and Deforestation Risk Index).

Table 13: Payments according to the Ecosystem and Deforestation Risk Index

Payment Area	Ecosystem	Deforestation Risk Index	Amount USD/ha
I	Cloud forest	Very High	$100
II	Cloud forest	High, medium and low	$70
III	Coniferous forest, deciduous forest, oak forest (oak-pine, pine-oak)	Very high, high, medium, low and very low	$38
IV	High evergreen forests	Very high, high, medium, low and very low	$55
V	Deciduous forest and thorny jungle	Very High and High	$38
	Hydrophilic vegetation (mangrove)	Very high, high, medium, low and very low	
VI	Deciduous forest and thorny jungle	Medium, low and very low	$28
	Arid and semiarid zones, Grasslands	Very high, high, medium, low and very low	

Source: Graf Montero 2012

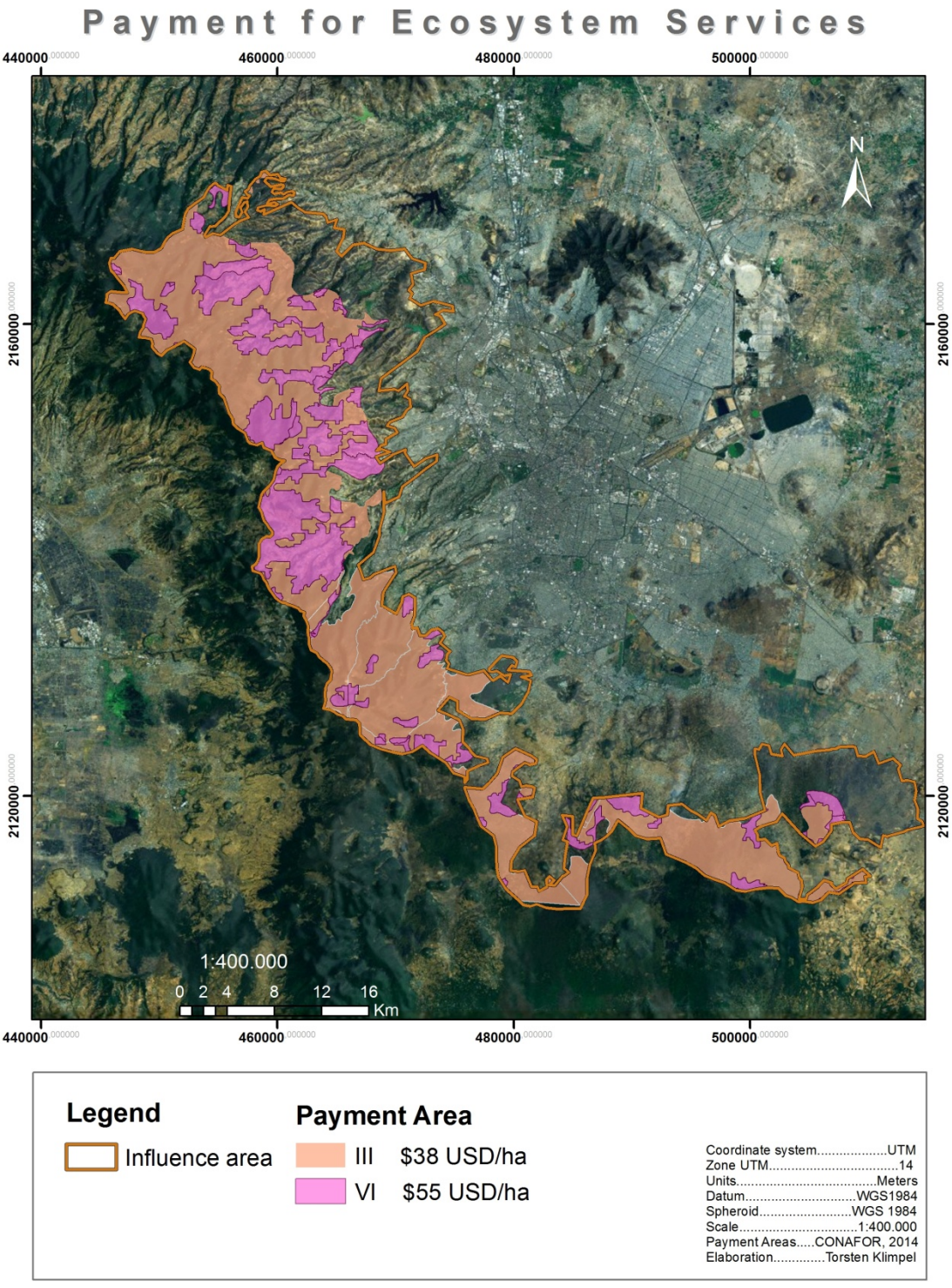


Figure 16: Differentiated Payments for Ecosystem Services

Most of the sites within the study area comply with the third category. Ecosystem: Coniferous forest, deciduous forest, oak forest (oak-pine, pine-oak); Deforestation Risk Index: Very high, high, medium, low and very low.

5.1.4.2 Forest Restoration Program in Priority Watersheds

The municipalities of the study included in the Forest Restoration Program in Priority Watersheds are linked to the restoration program of Cutzamala – La Marquesa and of Chichinautzin (CONAFOR 2013:). The CONAFOR selection of priority areas is based on criteria like land use, forest tree cover, type and degree of erosion and altitude of the area (CONAFOR 2013). As seen in Figure 17: Altitude of Mexico basin and forest restoration., most of the areas of the restoration program are located in the high basin (2600 - 3600 masl) are important recharge area for the Mexican Valley. The program has two components: Community Forestry and Forest Restoration. The support of the first component has the duration of one year and supports community land use management, technical expertise for recovering areas degraded by disturbances and community forestry. The second component finances activities for up to five years such as conservation practices and soil restoration, reforestation or protection against forest fires or pests and diseases (CONAFOR 2013).

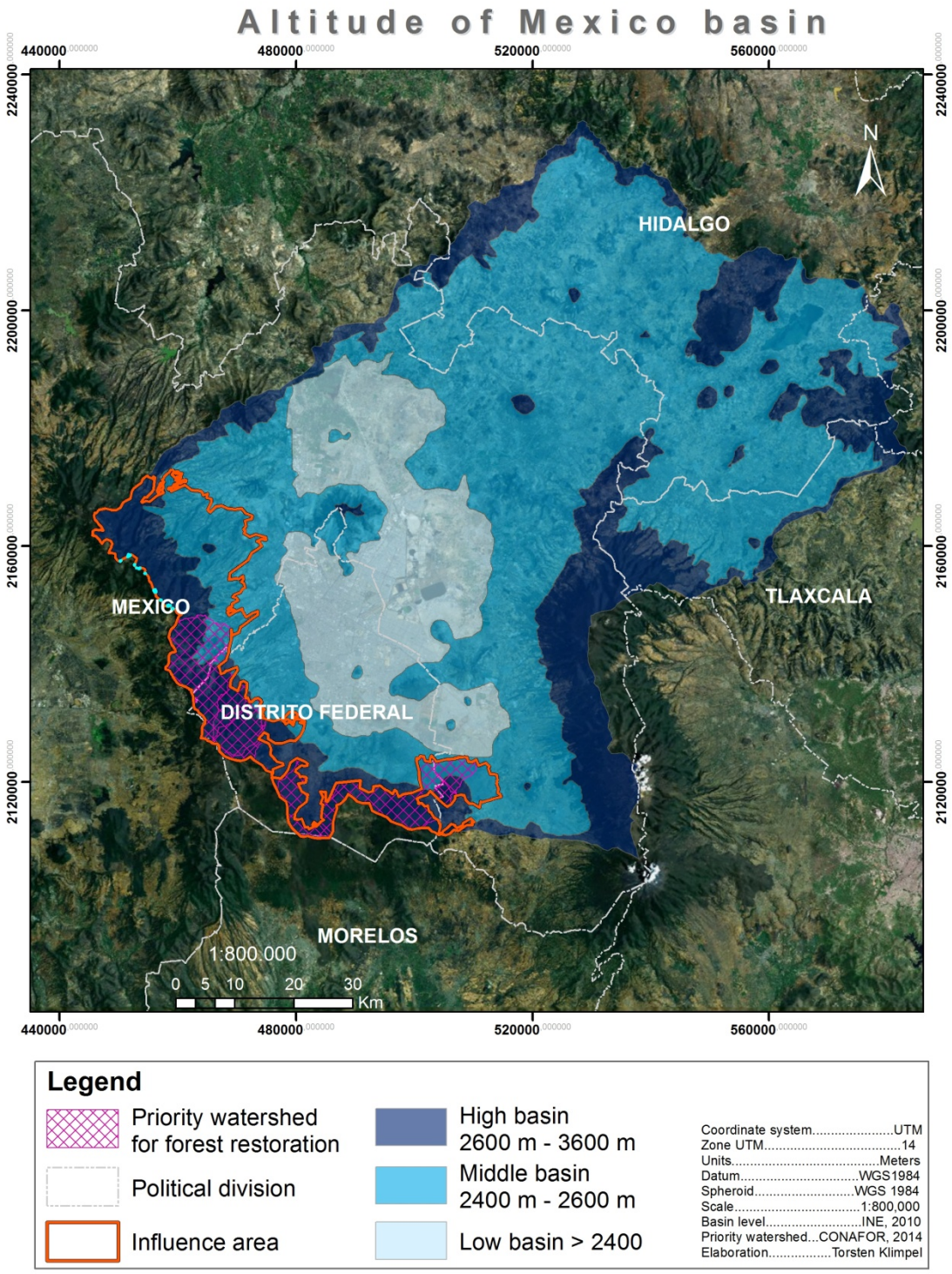


Figure 17: Altitude of Mexico basin and forest restoration.

Most of the influence area are located in the high basin and are identified as priority watershed for forest conservation of CONAFOR (2014).

5.1.5 Areas highly vulnerable to anthropogenic actions

5.1.5.1 Urban pressure

According to CONABIO the metropolitan area of Mexico City has the most anarchic growth in the world with the highest rates of expansion, with huge discharges of pollutants and, therefore, with severe impairment of populations of native species in their “natural” environment (Pisanty et al. 2009, p. 720). The degradation of natural habitats for native flora and fauna due to urbanization and fragmentation by highway construction are among the major problems threatening the biodiversity of the study area (Figure 18: Urban pressure). The disorderly and unregulated expansion of Mexico City has substantially contributed to the risks faced by several species, among others the *romerolagus diazi*. Several species are locally extinct such as white-tailed deer (*Odocoileus virginianus*), peccary (*Pecary tajacu*), wolf (*Canis lupus*) and the bobcat (*Lynx rufus*), which abounded in the forests of the basin, and the same applies to certain birds such as the wild turkey (*Meleagris gallopavo*) (Pisanty et al. 2009, p. 720). Hoth emphasizes that the most important challenge in this region is the regular, irregular or illegal progress of urban sprawl (Hoth 2012a). The irregular settlements (IS) are one of the main causes for the urban expansion in the federal district. These are localities in areas subdivided in social land (ejido) that was acquired, sold and occupied outside the institutional legal framework (not incorporated into municipal development plans or registered land, thus do not pay property taxes) (World Bank 2009). In several delegations of the study area irregular settlements (IS) have risen sharply in only one year. From 2010 - 2011 there have emerged 622 IS in the municipalities related to the study area with a total size of 124.71 ha (Table 14: Irregular settlements emerged in the study area).

Beside the urban expansion, several highways and roads are threatening the natural habitat of the study area. The highway 95D Mexico City - Cuernavaca as well as the highway 15 Mexico – Marquesa are affecting several protected areas. In addition to existing roads at least three road projects are planed that would cross the area of the water fund: The Autopista Lerma-Tres Marías, El Arco Sur highway project and Freeway Naucalpan-Toluca-Huixquilucan project (Hoth 2012a).

Table 14: Irregular settlements emerged in the study area

Delegation	Nr. IS	Area in 2011 (ha)	Increase to 2010 (ha)
Álvaro Obregón	14	26.57	8.32
Cuajimalpa de Morelos	68	261.83	5.86
La Magdalena Contreras	16	27.35	3.09
Milpa Alta	122	419.43	16.38
Tlalpan	93	1,016.65	36.75
Xochimilco	309	625.51	54.31
Total	622	2377.34	124.71

Source: SEDEMA 2013 p. 36

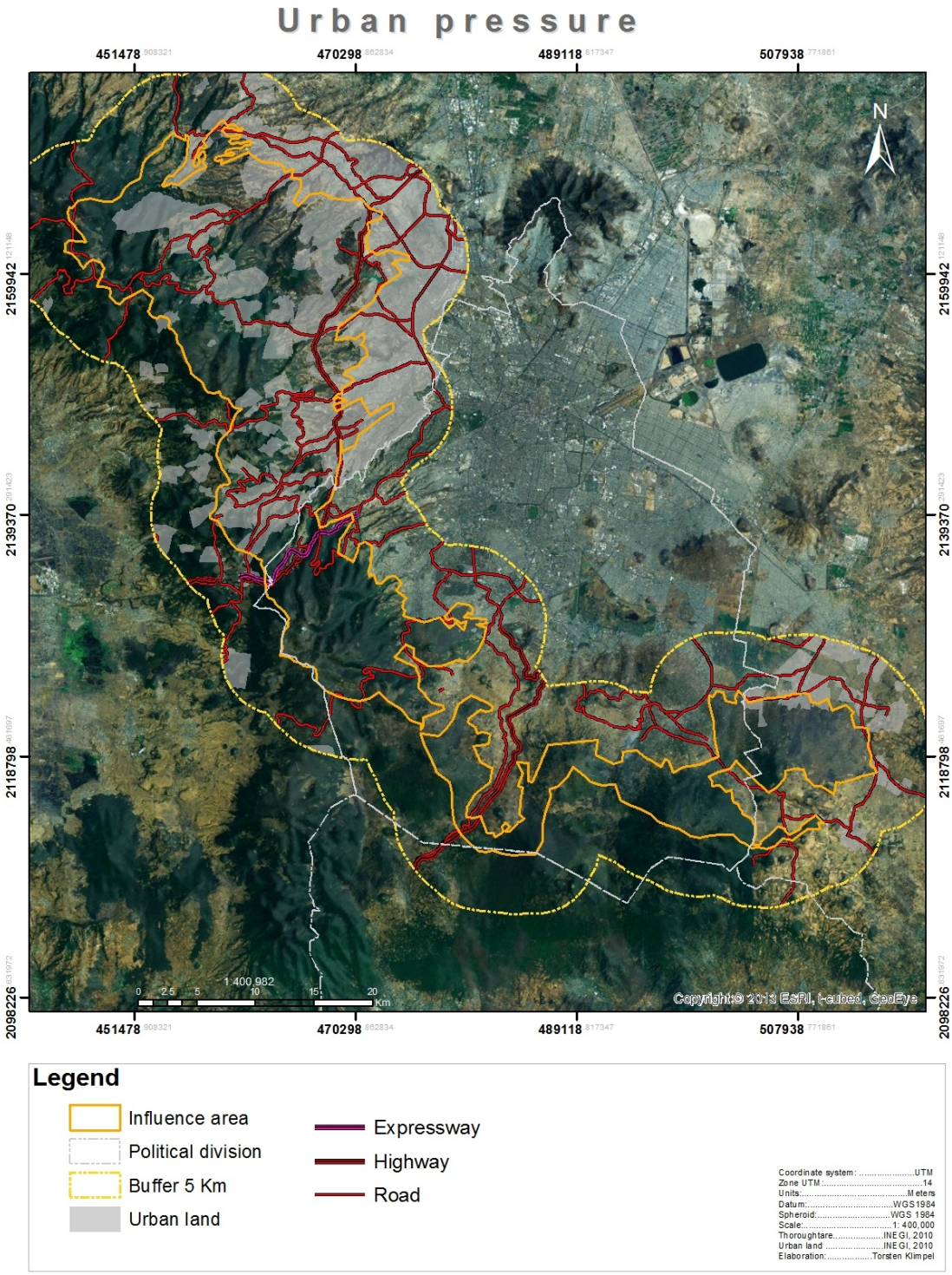


Figure 18: Urban pressure

5.1.5.2 Soil degradation

Soil degradation is the major threat to the biotic resources in the north of the study area. The degradation of vegetation causes soil erosion and the excessive soil loss in turn reduces the ability to absorb water and nutrients, leading to a degraded ecosystem (EDOMEX 2009a). The most common degradation processes are chemical (mainly by the loss of fertility) and hydric erosion (Figure 19: Types of soil degradation). The main causes of degradation are land use change for agriculture activities, overgrazing, deforestation and urbanization. The principal soil degradation appears in Altizapán de Zaragoza and in Naucalpan de Juarez and is mainly caused by excessive plowing agriculture practices. In the municipalities of Isidro Fabela, Nicolás Romero and Milpa Alta the soil degradation is caused by deforestation and removal of vegetation (Figure 20: Causes of soil degradation). According to Hoth (2012a) illegal logging has been one of the leading causes of deforestation in the Water Forest. Unauthorized or illegal logging is strongly linked to poverty, the land tenure scheme of forest land as well as the organizational structure of the communities and ejidos.

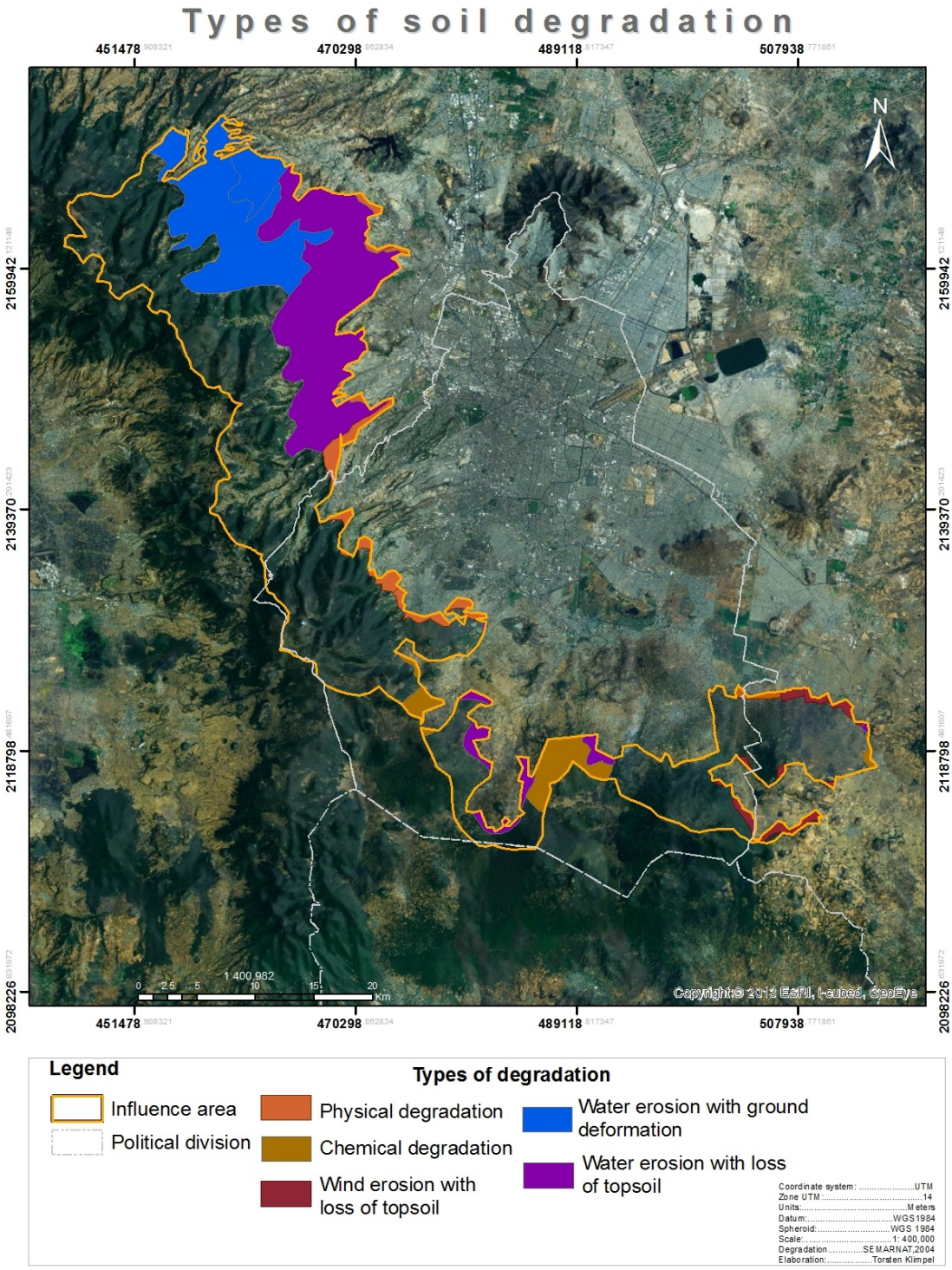


Figure 19: Types of soil degradation

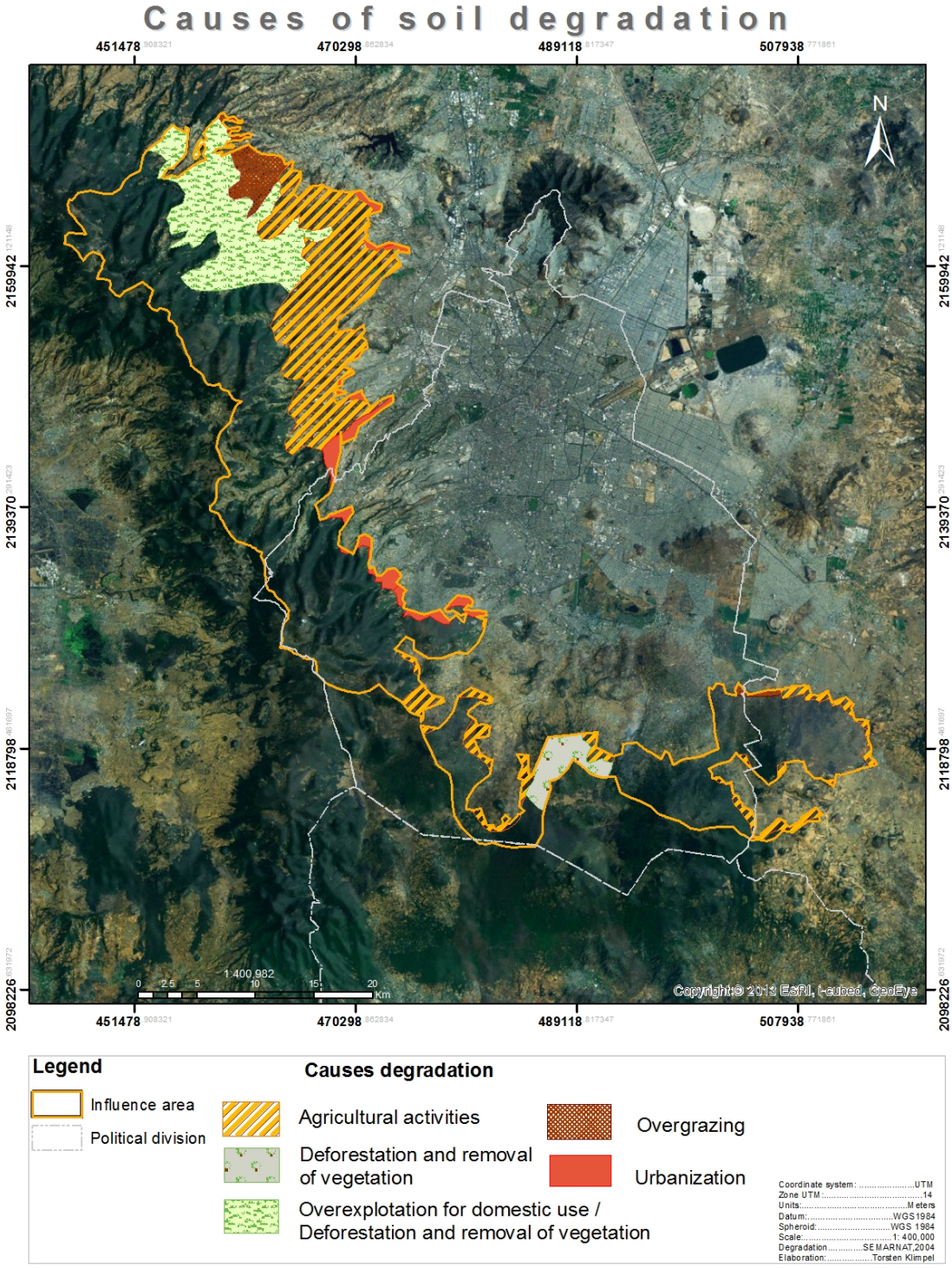


Figure 20: Causes of soil degradation

5.2 Analysis of the stakeholder

5.2.1 Stakeholder evaluation

Table 15: Evaluation of the stakeholders

Sector	Field	Stakeholder	Relation to water fund or study area	Inter.	Infl.
Public	Water company	FONADIN	The Fund provides financing for planning, construction and transfer for water and sanitation projects.	Low	Low
	Power generation company	CFE	Builds and operates dams which are used for generating electricity, supplying water to cities, irrigation and flood protection. Support the Water Fund "Fondo de Semilla" in Chiapas.	High	High
	National authority	The Federal Congress	Sets policies and approves budgets for the water sector, assesses and approves amendments to the National Water Law and its regulations.	Low	High
		CONAFOR	Responsible for protection, conservation, restoration and sustainable use of the forest. Provide funds to reduce soil erosion in upstream areas of river basins, restore areas of priority watersheds; participate in payments for environmental services through matching funds.	High	High
		CONANP	Heads the coordination and consolidation of SINAP. Responsible for PA management of the study area.	High	High
		SEMARNAT	Mexico's environment ministry is a member of the federal executive cabinet and is appointed by the president of the republic. Provide program of Environmental Management and Regulation; program of establishment or strengthening of UMA.	Low	High
		PROFEPA	Conducts environmental studies and monitors the quality of rivers, lakes and groundwater. The agency applies sanctions for violations of environmental regulations.	Low	Low
	Local environ-mental authority	Probosque	Preserves the ecological environment and conserve forest resources of the State of Mexico. Programs: Trust Fund for Payment for Hydrological Environmental Services of the State of Mexico (FIPASAHEM), Integral Micro-Watershed Restoration and reforestation program (PRORRIM).	High	High
		SEDEMA	Responsible for environmental protection of the Federal District. Programs: Air quality and climate change; soil conservation and biodiversity; supply and water quality.	Low	High

Sector	Field	Stakeholder	Relation to water fund or study area	Inter.	Infl.
		Basin Organism	Are, parallel to the Watershed Councils, decentralized bodies with governmental character, whose final decisions are competent to water authority. They are responsible for water management and planning. Includes representatives of federal, state and municipal bodies. These agencies have low civil society participation	Low	High
		PAOT	Develops studies to assist in the management, administration and protection of natural resources in the Federal District.	Low	Low
	Water authority	CONAGUA	The federal government body with the greatest responsibility for water resource management in the country. It is in charge of the development of the national water policy; administering the rights for water use and wastewater discharge; planning, irrigation and developing drainage systems. CONAGUA funds the majority of its activities with direct budgetary transfers from the Federal Government and with payments received for water use and wastewater discharge duties.	Low	High
		CAEM	Verifies the implementation of the State Water Program and the creation and consolidation of municipal water utilities in order to extend the coverage of water services in the State of Mexico.	Low	High
		SACMEX	Coordinates between municipalities and the federal government to improve water management and water and sanitation service provision in the Federal District.	High	High
		Municipal Gov.	Provides water and sanitation services directly (for example, through providers that are part of the municipal government) or through delegation to others (for example, to private operators through concession contracts or to utilities owned and operated by the state government).	High	High
	Irrigation Districts	SEDATU	Is in charge of land regularization, territorial and urban development and help in resolving conflicts over tenure.	Low	High
		SAGARPA	Promotes more efficient and productive water use in agriculture ensuring the sustainable use of soil and water resources	Low	High
		CETAMEX	Network of 25 rural organization; Elaborate studies and projects that promote sustainable rural development.	Low	Low

Sector	Field	Stakeholder	Relation to water fund or study area	Inter.	Infl.
	Research Institutes	IMTA	Decentralized public organization that is responsible for producing, implementing and promoting knowledge, technology and innovation for the sustainable management of water resources in Mexico.	Low	Low
		INECC	Generation of scientific and technical information on environmental issues. Department of Integrated Watershed Management, Study about systematization of successful cases of integrated watershed management in Mexico	High	High
		CONABIO	Applied research organization about biodiversity, develops human capacity in the field of biodiversity informatics, maps of the hydrological priority region; Developed a national monitoring system of hot - spots across the country, links the academia, government and civil society.	Low	High
	Party	Partido Verde	Proposes to reform the National Water Act to include a title on Watershed Conservation and establish novel criteria for watershed organization, with emphasis on the natural availability of water; payment for environmental services in watersheds.	Low	Low
Private	Water companies [7]	AMSA	Concessionaire of Sacmex to provide drinking water supply, drainage and sewerage, and treatment of wastewater in Mexico City. Operates in: Tlalpan, Magdalena Contreras, Alvaro Obregón, Miguel Hidalgo y Cuajimalpa	High	High
		IASA [8]	Concessionaire of Sacmex. Areas of sales management, including bill collection, management of industrial customers and the connection of new customers. Area of operation: Venustiano Carranza, Iztacalco, Benito Juárez, Coyoacán.	Low	Low
		TECSA.[9]	Concessionaire of Sacmex. Area of operation Iztapalapa, Tláhuac, Xochimilco, Milpa Alta.	High	High
		SAPSA[10]	Concessionaire of Sacmex. Area of operation: Miguel Hidalgo, Álvaro Obregón, Cuajimalpa, Magdalena Contreras, Tlalpan	High	High

[7] The four concessionaires trading system and maintenance of the hydraulic infrastructure and network of the Federal District are subsidiaries of major global water partnerships http://www.eluniversal.com.mx/ciudad/77025.html

[8] Owned by the British United Utilities

[9] Joint venture between Suez-Ondeo and Mexican partner Peñoles (BAL Group, one of the major groups in Mexico, main business: mining & insurance).

[10] Constituted by the large Mexican construction firm Ingenieros Civiles Asociados (ICA), with the Bank Banamex and the French firm Générales Des Eaux (Vivendi),

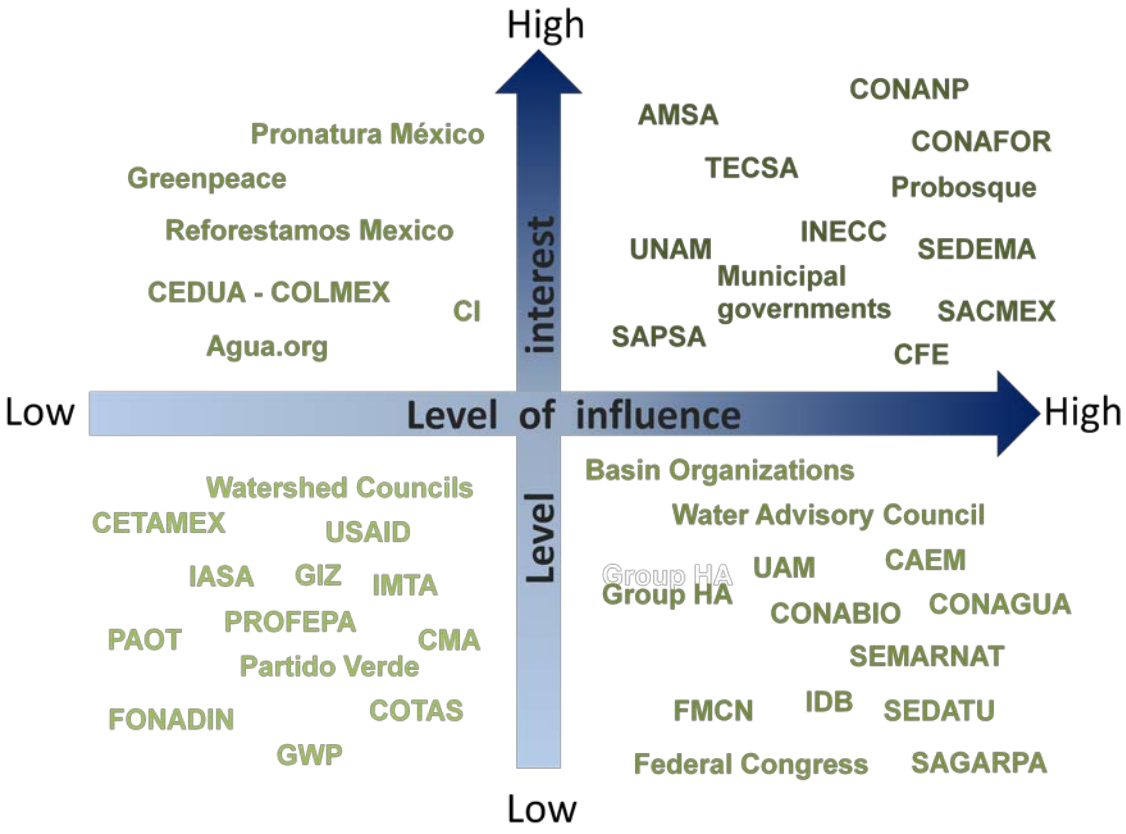
Sector	Field	Stakeholder	Relation to water fund or study area	Inter.	Infl.
Aca-demic	Research center	Group HA	Analysis and interpretation of water quality and soil, calculation of the water footprint, specialized consultations on water risk indicator, hydro geological exploration, geochemical modelling, among other.	Low	High
	Univer-sities	UNAM	The Water Network UNAM (RAUNAM), Investigation about: Financing models for watershed management - Dra. Luisa Paré; Geospatial data for decision making of water management - Dr. Luis Marín; Protection and restoration of vital ecosystems- Dr. Luis Zambrano González, National Network for Water Research in Mexico (RETAC-Conacyt) - Dr. Ursula Oswald;	High	High
		UAM	Water Production Center Xochimilco (CEPAX) - Francisco Romero; Investigation about economics of water - Dr. Lilia Tapia, Center of sutainability Incalli Ixcahuicopa (CENTLI) - Elena Burns	Low	High
		CEDUA - COLMEX	Conducts researches that contribute to the advancement of knowledge in the fields of population, urbanization and environment in the area of the Water Forest.	High	Low
		Water Advisory Council, B.C.	It describes itself as a civil, pluralistic and independent body with legal personality and its own administration. However, it is important to note that its members are summoned by the Federal Government.	Low	High
Civil society	Assoc. of water boards	Watershed Councils	Its purpose is to promote integrated watershed management, sustainability and local participation. It also participates in the management of conflicts. Recently it has included more users and organizations representing citizens (50%), their powers are limited which prevents a real impact.	Low	Low
		COTAS	The Technical Committees for Subterranean Waters participate in developing policy and program proposals related to the aquifers.	Low	Low
		Agua.org	Communication and environmental education of water resource management in the Mexican Valley.	High	Low
	CSO	Pronatura México	Reforestation program in the Mexican basin; Rainwater harvesting project, Ajusco Education Centre.	Low	High
		CI	New Project in the Water Forest. Defined three priority conservation sites: Coajomulco and Nepopualco (Morelos); and Topilejo (Federal District).	Low	High

Sector	Field	Stakeholder	Relation to water fund or study area	Inter.	Infl.
		FMCN	Conservation, Forest and Watershed Program (PCByC), Learning Community of the Watershed and Cities Program (also linked to the Mexican Basin)	Low	High
		Greenpeace	Opponent to the highway projects: "Autopista Lerma-Tres Marías and Ramal Tenango"	High	Low
		CETAMEX	Network of 25 rural organizations; Elaborates studies and projects that promote sustainable rural development.	Low	Low
		Reforestamos Mexico	Link to the Program "Profitable Forest - Sustainable Forest", Participates in the initiative of the Water Forest	High	Low
Intern. Coop	Multilat. Coop	WWC	Organization created to discuss changes in water policies, promote World Water Forums, among its members is the World Bank (WB) and government agencies, UN agencies and some civil society organizations (CSOs).	Low	Low
.	.	GWP	Created by the World Bank, the UNDP and the SIDA as a space in which governments, development agencies, the private sector and associations can build alliances and exchange information. Absence of organized civil society in this organism is notorious.	Low	Low
		IDB	It is a regional bank that has lent to Mexico for various water and sanitation projects. One of its main functions is to promote private investment for projects in the region.	Low	High
	Gov. Agencies	GIZ	Experience of water management in Río Lerma in the Valley of Toluca and Río Balsas; Participation in the CONANP Program for Adaptation to Climate Change CESMO.	Low	Low
		USAID	Participation in the finance of the water fund Valle del Cauca – Colombia	Low	Low

Table 15: Evaluation of the stakeholders. Based on interviews with experts (Annex 1) and by literature review: OECD 2010, p. 10; ECOBA 2012; CEMDA 2006; Gutiérrez et al. n.d.; Alcaraz 2006; Gutiérrez and Ayala 2013; SACMEX 2014.

5.2.2 Key stakeholders

The stakeholder analysis shows different clusters of organizations dominating each cell of the matrix (Figure 21: Key stakeholders).



The organizations with high influence on the implementation of the water fund can be divided in three groups:

a) Organizations with administrative and legal hierarchy on the natural resources in the study area. The ministries of agriculture SAGARPA and of the environment SEMARNAT are responsible for developing political guidelines for the conservation and exploitation of natural resources. These are transposed executed by the environmental commissions CONAGUA, COANFOR and CONANP through several programs and projects.

b) Organizations that are in control of strategic financial and data resources. Financial support could be obtained from the Federal Electricity Commission and the International Development Bank which are both supporting other water funds initiatives. More financial resources for the environmental sector can be approved by the federal congress. Important

investigation studies about the study area are developed by the governmental research institutes INECC, IMTA or CONABIO and the academic sector UNAM and UAM.

c) Local authorities and watershed councils. Contact with civil society, communities or smaller organization (for example in the rural sector) can be established by the municipalities and local environmental authorities (Probosque and SEDEMA). The decentralized bodies like watershed councils and basin organizations can offer a space to include these groups in the decision process on water resource management.

Organizations with high interest in the implementation of the water fund are environmental CSOs (civil society organizations) with conservation projects in the study area. The water fund can offer financial and technical benefits for the CSOs linking all short-term conservation efforts into a single long-term conservation strategy. Beside CSOs the private water companies have a vested interest by launching a water fund, as they can ensure their “product” for the future without investments on new technical solutions. Of course, to assure a stable water supply in the future, a strong regulation is also required as well as a reduction in water resources demand.

6 Results

6.1 Funding opportunities for the water fund

Protected Areas

According to the objective of the National Commission of Protected Areas, until 2018 the number of PAs with management plans is expected to increase from 115 (2013) to 155 (2018) (Total amount of 166) (CONANP 2013). As mentioned before an effective management of the PAs requires a budgetary increase of US$ 2 billion over the next eight years, which cannot be covered only by the government (Bezaury-Creel et al. 2011). The water fund could support the development of management plans in the study area and invest in community participation in the areas. Furthermore, the collaboration with CONANP could inspire the German Society for International Cooperation (GIZ) to participate in the Water Fund. Most of GIZ projects in Mexico are linked to CONANP - they even have an office within CONANP (Wittmann, T., personal communication, 2014). The participation of GIZ could generate new financial and technical resources to the water fund.

National Protected Areas System (SINAP in Spanish)

In all Mexico until now 61 of 166 PA are registered in SINAP, but only one PA of the influence area is registered in SINAP. Even Mexico´s oldest protected area “Desierto de los Leones” located in the study area is not registered, which limits the possibility to receive financial support from the protected area fund (FANP) financed by the heritage resources of the Global Environment Facility (GEF) (CONANP 2011). The analysis has shown that the PAs located in the influence area are fulfilling several criteria to be part of the SINAP: High species richness and presence of endemism and importance of environmental services generated by the protected areas. Based on this, the water fund could collaborate with FANP to include some of the PAs of the study area in SINAP.

Payment for ecosystem services in eligible areas

In comparison to other land use possibilities the payment for ecosystem services program of CONAFOR doesn´t create enough incentives to avoid land use change. According to Hoth (2012) the income generated by oat cultivation is $770

– $1615 USD/ha[11], by maize cultivation $1150 USD/ha[12], by tourism $2700 USD/ha[13] and by real estate $2,000,0000 USD/ha[14] is much higher than the payments for ecosystem services given by CONAFOR ($28 – $100 USD/ha) (Hoth 2012b). One possibility to increase these payments could be by complementing them with the water fund. CONAFOR developed the financial mechanism "matching funds" to involve private companies interested in participating in the PES program. Companies have to contribute with 50% or more and CONAFOR completes the payment. Another advantage offered by this scheme, is that payments instead of being limited to a 5 year time frame, in the case of CONAFOR's Payment for Ecosystem Program (PSA in Spanish), can be made up to 15 years. The amount paid for watershed services is 8.5 USD/ha/year of the minimum wage in the Federal District per hectare per year for a cloud forest, 7.5 USD/ha/year in an oak forest and 6.5 USD/ha/year in other types of forests and jungles (CONAFOR 2007).

6.2 Conservation opportunities of the influence area

Land tenure

Similarly as in all of Mexico, most of the land in the study area is social property (community and ejidos). During recent years the creation of private nature reserves has been an efficient instrument for the conservation of natural resources in many countries. In this scheme, the owner of the area retains its full land rights but agrees to manage it according to the regulations issued by the System of Natural Protected Areas of Mexico (Quijada Mascareñas 2004, p. 3). The water fund may support private land conservation like conservation easements, private reserves or usufructs. The environmental CSO Pronatura which has experience in private land conservation (since 1998) and can collaborate in the conservation program of the water fund.

Threatened species

The threatened species *Leptonycteris nivalis* and *Romerolagus diazi* are part of the CONANP conservation program for species at risk (PROCER). The program

[11] Fluctuates according to the season
[12] Data source obtained of the community Huitzilac located in the Water Forest
[13] Average Value
[14] Data source of Santa Fe, Cuajimalpa.

seeks to recover 35 identified species at risk, as well as populations of associated species and of the same habitat. Umbrella species were selected for the proposed actions which facilitate not only the recovery of species at risk, but also that play an important role in the ecosystem (CONANP 2009, p. 1). As part of the program CONANP developed in 2012 an action plan for the conservation of the species *Romerolagus diazi*. This plan proposes, among other things, to increase until 2016 the number of hectares of *Romerolagus diazi* habitat by any conservation scheme (PA, UMA, certified voluntary conservation hectares, Conservation easements, etc.) (Cruz Molina et al. 2012). This measure can increase the protection of the study area in the future.

Important Bird Area

Birdlife organization developed a monitoring framework to provide a standardized way to assign scores for threats to IBAs ('Pressure'), the condition of IBAs ('State') and conservation actions taken at IBAs ('Response') (BirdLife International 2006, p. 3). The water fund monitoring programs of TNC include, among other parameters, the diversity; composition; abundance; presence/absence of birds as indicator species for monitoring terrestrial habitat and biodiversity (Higgins and Zimmerling 2013, p. 68). For the monitoring program of the water fund it could be valuable to link the international standards of BirdLife with the TNC standard for monitoring water funds. Once the indicators are standardized the obtained information can be analyzed, compared and integrated into an environmental information system for the management of species at risk (Ortega-Argueta and Contreras-Hernández 2013).

Identification of eligible areas

The PSA program was designed to provide economic forest land owners incentives for conservation practices and to avoid land use changes of forest areas (CONAFOR 2012a). The eligible areas are identified by ecosystem and risk of deforestation. This would make sense if deforestation due to land use change was the main cause of loss of watershed services and by; if the payment of the opportunity cost of the land to the owner was be enough to stop deforestation trends (Madrid Ramirez 2011, p. 53). According to Madrid Ramirez (2011) there is enough scientific evidence to say that the loss of water services is mainly caused by mismanagement of land and territory (including agrochemical pollution,

garbage and sewage, erosion caused by the building of roads and infrastructure and poor agricultural practices, highly polluting activities such as mining, etc..) than by forest loss. The identification of priority areas by InVEST can offer a new methodology to identify eligible areas for the PSA program. A close collaboration between CONAFOR and the Water Fund for the selection of conservation areas could bring mutual benefits.

Forest Restoration Program in Priority Watersheds

The PSA program was designed to provide economic forest land owners economic incentives for conservation practices and to avoid land use changes of forest areas (CONAFOR 2012a). However, this approach to conservation payments of wooded polygons ignores the value of other land uses and the value of the integrity of the territories for the provision of ecosystem services (Madrid Ramirez 2011, p. 53). The Mexican Civil Council for Sustainable Silviculture (CCMSS) and the water fund of the Valle de Bravo (located in the watershed of the Mexican valley) developed a PES scheme that rewards other land uses like good agriculture practices or water management. This integrated land use approach is based on the development of territorial management plans at community, ejido or even plot level (Madrid, L., personal communication, 2014) The water fund needs to include an integrated land use approach and take advantage of CCMSS's experience.

Urban expansion

The Federal District's Secretary of the Environment is developing a "Telematics Network for Monitoring and Surveillance of Soil Conservation" to allow greater presence of authority in rural areas and faster response against environmental crimes such as illegal logging and soil invasion (SEDEMA 2013). Besides these efforts, the Secretary works with SEDUVI, PAOT and UNAM in developing a strategy to determine the consolidation, degree of risk and environmental damages of irregular settlements. Based on this strategy it will promote alternatives to help determine IS policies to avoid continued soil loss (SEDEMA 2013). For the water fund it will be important to involve the policies strategy of the Secretary in its conservation management plans.

Soil erosion

In response to soil loss CONAFOR started the “Soil Conservation and Restoration Program” to facilitate the restoration of forest soils of Mexico and to incorporate the restored soils into a sustainable management scheme (Ángel-Mobarak 2012). The landowner receives financial and technical support to develop conservation practices on their land to prevent soil losses (CONAFOR 2010). For the water fund it would be necessary to promote soil restoration activities in the affected areas of the study area (Altizapán de Zaragoza, Naucalpan de Juarez, Isidro de Fabela, Nicolás Romero and Milpa Alta). Additionally, CONAFOR has set the goal of implementing a system that allows knowing the costs involved in soil restoration in different areas of the country. This would generate valuable information to determine the benefits of restoring soils in Mexico (Ángel-Mobarak 2012). The cost – benefit analysis is also an important pillar in the water fund strategy to convince stakeholders to pay for conservation activities (Calvache et al. 2012). Exchanging data with CONAFOR gives new arguments to justify the implementation of the water fund.

6.3 High priority areas

Both areas are located in the upper part of the Mexican watershed, are classified as IBA; high priority (GAP) and priority Watershed area (CONAFOR) and both are under urban pressure due to expansion of irregular settlements. However, they are not subject to special protection by the CONANP (Table 7: Filters to identify the high priority areas). By excluding the protected areas and including only the larger contiguous areas (defined as connected areas without fragmentation) there can be identified two main priority areas in the study area. The first priority area (defined with A) is divided in the municipalities Alvaro Obregon, Cuajimalpa de Morelos, la Magdalena de Contreras, and a small part of Tlalpan. The second priority area (defined with B) is located in the municipality Milpa Alta (Figure 22: High priority areas of the influence area).

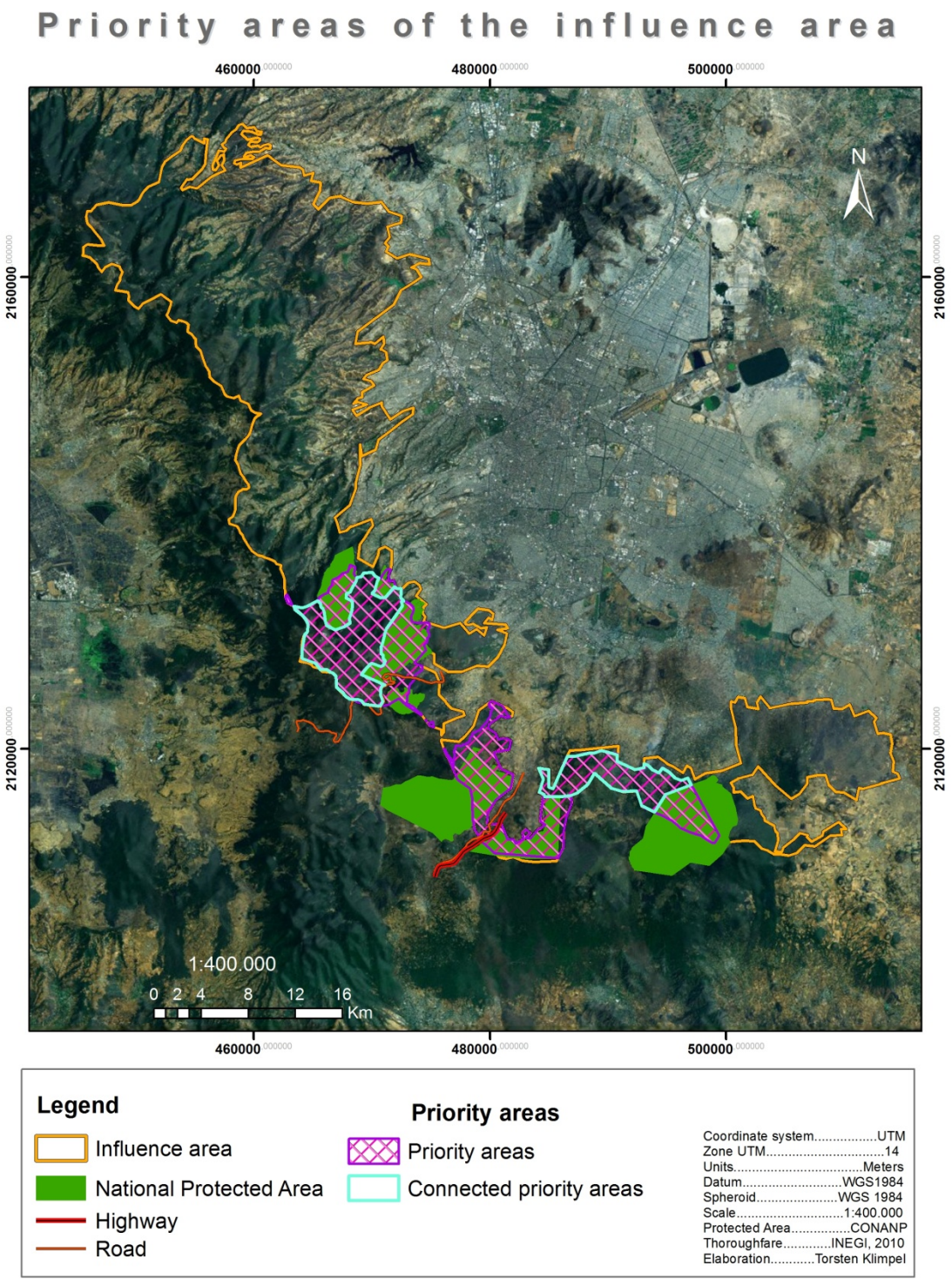


Figure 21: High priority areas of the influence area

The priority area A contains one large oyamel forest area, which distribution is extremely limited in Mexico (Jaramillo Correa and Martinez Méndez 2014). The Oyamel (Abies religiosa) is mainly located in sites with deep well-drained soils rich in organic materials and thrive in altitudes from 2400 to 3600 m and on slopes of moderate to strong (SAGARPA n.d.). The Monarch butterfly overwintering colonies are found in the oyamel forest. Pine forest and grasslands are also dominant vegetation in the priority area A. The species *acer negundo mexicanum* classified under special protection appear in the east of this area (Figure 22: Characteristics of the high priority areas).

According to the study of Navarro-Frias et al. (Navarro-Frías, Javier, González-Ruiz, Noé and Álvarez-Castañeda Sergio 2007) 45 native species of mammals are distributed in the Milpa Alta Delegation and most of them are distributed in the southern highlands with coniferous forest. The predominant vegetation in the priority area B is the cool temperate forest with pine and pine-oak forests (Figure 22: Characteristics of the high priority areas). Melhcalhca and Texcayuca (Ojo de agua) are the only localities in the priority area and San Pablo Oztotepec is the next larger community close to the area. The main problems in this locality are deforestation (vegetation is 30 % of full) and overexploitation of the natural resources, as well the lack of internal or external regulation (SAGARPA n.d.). There are two mayor agriculture areas visible in the priority area B that could be the cultivation of nopal, corn, beans, squash, vegetables, fodder, fruit (according to the main cultivation in San Pablo Oztotepec) (SAGARPA n.d.).

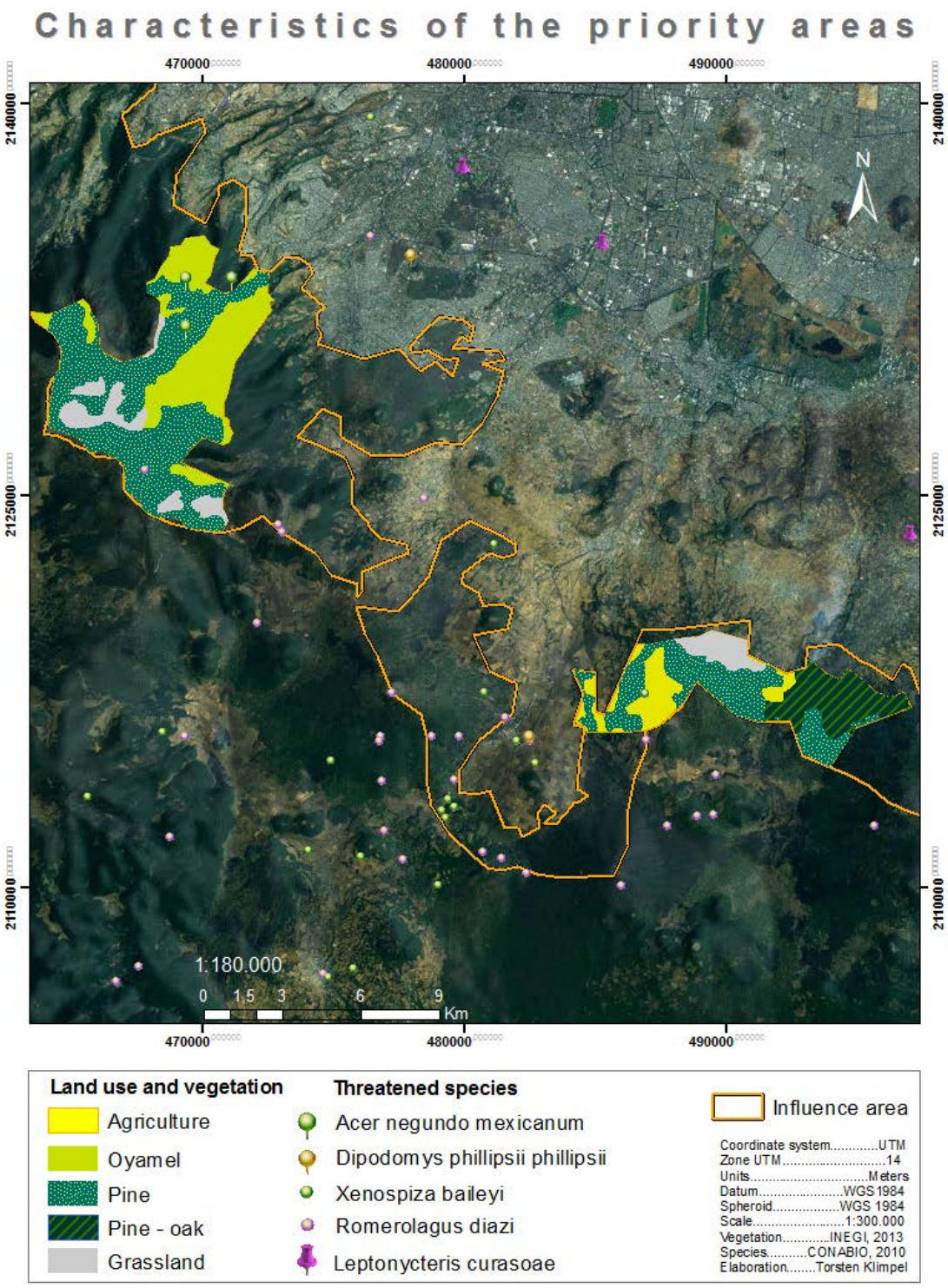


Figure 22: Characteristics of the high priority areas

6.4 Stakeholder participation in the water fund

The developed matrix (Figure 6: Stakeholder matrix), groups the stakeholder in four categories which can be used to differentiate the level of participation. Depending on the level of interest and influence of the stakeholders, the participation range from a minimum of simply informing stakeholders through to empowerment in which the stakeholders or some subset of them are given final decision-making authority (Bryson 2004).

The opportunities for stakeholder participation in the water fund are analyzed by each category:

Low interest and low influence:

The stakeholders with low interest and low influence are the least important for involving in the water fund. Most of the international cooperation like the WWC, GWP, GIZ and USAID, some councils of civil society like COTAS, watershed councils or the network CETAMEX and other institutions (PAOT, PROFEPA, FONADIN, IASA, IMTA, IASA and Partido Verde) belong to this group. These organizations can be informed via general communications, newsletters, websites, and mails with the aim to increase their interest of participating in the water fund in the future.

High interest and low influence:

Most of the organizations with high interest and low influence are environmental CSOs that are already executing projects in the study area or that could be linked in the future to the water fund. According to Bryson (2004) these stakeholders are potential supporter for the water fund and need to be kept informed and consulted on their areas of interest.

Several personal interviews were carried out in the course of the present research to analyze the potential participation of CSOs in the water fund:

a) Conservation International (CI) – Jürgen Hoth, Director of the Water Forest Project

CI started together with representatives of Federal, State government, municipal, academic institutions, including CONANP CONAFOR, CNA, PROFEPA , UNAM-FC, COLMEX, UAEMor and various CSOs the identification of priority

conservation sites in the Water Forest. Three sites were identified - Coajomulco and Nepopualco (Morelos); and Topilejo (Federal District) - using indicators such as location (away from urban areas), hydrological - environmental, social, economic, ecological and planning criteria. As a next step in this initiative, sponsored by the Gonzalo Rio Arronte Foundation and CI, geohydrological models to assess the water catchment of the aquifers, wastewater collection schemes and impact evaluation schemes will be developed as well as an annual forum for sharing the information. The identified sites by CI are complement the conservation priorities identified by the present study and cover the whole area of the water forest. The further conservation efforts in Topilejo (D.F.) can be supported by the water fund's resources and by the information of the present study.

b) Reforestamos México – Emilio Cruz, Assistant Manager of public policy.

Reforestamos México organizes for private companies small reforestation events in Topilejo, (D.F.). They have also been working in the past five years in the "Nevado de Toluca"[15] in different productive projects. Together with local communities they implemented trout hatcheries, a forest nursery, greenhouse hydroponic forage and sheep management. The experiences in the design and implementation of a community development projects are valuable for the water fund. The focus on developing small community enterprises to change the mentality of the local people regarding natural resource management could be an important aspect in treating the dominating private land tenure in the study area.

c) Pronatura Mexico – Eduardo Cota, Director of Ecosystem Conservation and Restoration Program.

The restoration and watershed program of Pronatura Mexico has seven components: ecological restoration; community nurseries; soil restoration for water recharge; productive projects to generate local economy; water availability through artificial basins as water collectors, backyard gardens and environmental education. Today the program operates in 1,199 sites in all of Mexico. The construction of water collectors could be an interesting model to apply in further

[15] On October 2013, the Mexican president Enrique Peña Nieto changed the status of National Park Nevado de Toluca, awarded by Lázaro Cárdenas in 1936, to area for the protection of Wildlife.

water fund activities (Figure 24: Water collector). These artificial basins are dugthen protected with a PVC geomembrane that accumulates rainwater which slowly seeps into the groundwater. The storage capacity of rainwater is between 6000 to 32500 m³. Pronatura supports the community with heavy machinery and technology and the community is in charge of small work (stone removal) and maintenance of the water collectors.

Figure 23: Water collector
Santiago Bayacora in Durango, Pronatura México 2014

High influence and low interest

The organizations belonging to this category are mainly governmental organizations, basin council and research institutes. The water fund has to meet their needs and try to increase their level of interest by engaging and consulting them. CONAGUA is the “highest authority in charge of the administration of national waters and their public goods” in Mexico and therefore with very high influence in the water fund (Cámara de Diputados del H. Congreso de la Unión 06.07.2013). The conservation measures of the water fund focus on stabilizing the offer of water resources. However, to guarantee water resources in the future, it also needs to minimize water extraction from the aquifers – which is only possible in collaboration with CONAGUA (Reyes, J. A., personal communication, 2014).

In the aquifers of the Mexican valley CONAGUA does not grant new water extraction concessions. It created a system called water banking to exchange the

existing water concessions (Salgado, J., personal communication, 2014). This has the objective to provide equitable access to water resources and to collect information on the availability of water in the specific hydrological-administrative region (CONAGUA water banking). The water fund needs to include the gained information and try to incorporate CONAGUA. However, in the water fund of Monterrey CONAGUA was only interested in inviting members of the water fund's executive council to meetings of the watershed council (Rovalo, M., personal communication, 2014).

High interest and high influence

The organizations with high interest and high influence are the key players of the water fund. The main efforts focus on this group, which is made up of environmental authorities, private water companies and research institutes. The water fund committee needs to involve them in governance and decision making bodies and to engage and consult them regularly.

CONANP can be classified as the most important organizations for the water fund. According to its own information, it can be included in all activities of the water fund: identification, planning, implementation, monitoring and evaluation (Montiel, R., personal communication, 2014). This can be done by including CONANP's Information, Monitoring and Evaluation System for Conservation (SIMEC). It has the general objective to incorporate biological, geographical and social indicators, which allows presenting the results on the effectiveness and impact on the implementation of public policies in PAs (Montiel, R., personal communication, 2014). Through the installation of 53 Automated Weather Stations (EMA) in PAs, meteorological data can be monitored. Moreover, the Annual Action Program (AWP) provides the framework for species monitoring and water quality, soil, etc evaluation. There are community projects set out in the Subsidy Programs that offer on site biological monitoring (Montiel, R., personal communication, 2014).

In the study area CONANP is developing the project: "Biodiversity Conservation in the Neovolcanic Axis", whose goal is the conservation of ecosystems and environmental services provided by PAs located in the Transverse Volcanic Belt, particularly in the high basin of Rio Lerma. The objective will be pursued through specific actions for adaptation and mitigation of climate change, with a focus on

watershed and landscape conservation actions and strengthening mechanisms of inter and intra institutional coordination, especially with GIZ (Montiel, R., personal communication, 2014).

7 Discussion

7.1 Research study

According to ALFA, there are two major questions in the process of water fund implementation. First it is important to know *where to develop new water funds* and second it is necessary to decide *where and how each fund should be spent* (ALFA n.d.).

The first question was answered in the research study using a simple method. Two different initiatives have been linked, the initiative of the Water Forest and the initiative of ALFA to implement a water fund in the watershed of Mexican Valley, by their common interest to protect part of the recharge area of the Mexican basin. The merger of the initiatives is based on a GIS overlay of both areas of influence.

The identification about where and how the fund should be spent was done by analyzing the conservation priorities, the funding opportunities for conservation projects and stakeholders interested in maintaining ecosystem services. Resuming the analysis, there have been a series of important sites identified close to urban area and located in the upper basin of the Mexican Valley. Several factors like irregular settlements, endemic species, protected areas or programs of payments for ecosystem services influence the decision about further conservation measures and funding opportunities of the water fund. It depends on the flexibility of the water fund to include the varying local conditions in one congruent conservation plan. The stakeholder analysis gives an overview of potential stakeholder participation in the water fund determined by level of interest and level of influence. In particular the governmental organizations CONAFOR and CONANP offer a series of programs that could be linked to further water fund activities. The water fund can serve as a platform to unite all the initiatives and provide financial support to complement the different conservation efforts.

7.2 Limits of the research

In the Metropolitan Area of the Mexican Valley live over 24 million people (INEGI, 2010) and the area of the Water Forest is divided by three states and 37 municipalities. Even reducing the study area on the part of the Water Forest that

belongs to the watershed of the Mexican Valley, there are several stakeholders, especially on the local level that are not involved in the analysis.

TNC uses the Integrated Valuation of Ecosystem Services and Trade-offs Tool (InVEST) to prioritize the areas in the Mexican Valley according to the highest ecosystem services return. The tools help to understand how water services operate in the watershed and how these can be affected by land use changes, infrastructure development or climate change (P - Ortega et al. 2013). It requires special training course and detailed ecological and hydrological data that were not available for the research study (Hesselbach, H., personal communication, 2014).

The objective of the research study was to focus on the opportunities to implement the water fund and does not analyze the feasibility to implement the water fund (which requires the ALFA methodology). The implementation and operation of a water fund depends in the end on the willingness of the stakeholders to pay and to participate in the water fund. This decision precedes a negotiation process and several external factors (government changes, economic crisis etc.) that can limit the implementation process. It takes seven to ten years from its creation to its implementation and requires constant investments of several institutions (Aranda, J. L., personal communication, 2014). Due to this fact, a feasibility study was not possible.

7.3 Results

The results of the present study can be compared to operating water funds (FONAG, FAMM and FSA).

Similarly as in the influence area of the Mexican Valley, the Upper Guayllabamba River in Quito is affected by an accelerated urbanization that involves uncontrolled growth in the margins of the city and the growth of informal settlements. There is increased erosion by land use change, by urban growth and agricultural expansion. Several protected areas (12% of the area) are located in the upper Guayllabamba River to preserve and protect the environment in the basin. There is also high vulnerability to natural disasters like geophysical (seismic and volcanic) as well as hydro-metrological (floods).

In contrast to the area of the Mexican Valley (16,424 km²), the operation of the FONAG covers an area of only 4,710 km². There live over 2 ½ million people in comparison to the 24 million inhabitants in the Mexican Valley.

The relevant actors that the stakeholder analysis identifies can be compared with the stakeholder participating in the Mexican water funds FAMM (Monterrey) and FSA (Chiapas):

- The governmental organizations CONAFOR and CONANP play a crucial role in the FAMM and FSA as well; they are identified as a key player in the stakeholder analysis.
- The international organizations IDB and GEF as well the Mexican Fund for Nature Conservation (FMCN) are participating in the promoter group of both Mexican Water Funds but are not classified as key players in the analysis. This recommendation has been taken due to the uncertainty of interest to finance a third water fund in Mexico.[16]
- Organizations like TNC, FEMSA Foundation and Coca Cola Company are mainly supporting FAMM and FSA but are not contemplated in the stakeholder analysis. They are already participating in the promoter group of the Mexican valley water fund initiative and a re-consideration will not make sense.
- The environmental NGO Pronatura A.C. plays an important role in the FAMM and FSA. In the stakeholder analysis Pronatura Mexico (which differ from Pronatura Chiapas and Pronaturea Noreste) was identified as an organization with high interest but low influence, due to its low amount of projects in the influence area.

7.4 Challenges of the water fund

The thesis analyzed the opportunities to implement a water fund, without directly taking into account the challenges of such an implementation. During the interviews several concerns arose about the success for implementing the water fund. Below are some of the personal concerns listed:

[16] I tried to get an Interview with Rossana Landa Perera of the FMCN but without success. All the international organizations are still not supporting the fist feasibility studies for the Mexican Valley watershed.

Conflict of interest: In the study area there are many players with different interests. For example companies in Santa Fe, a large business district characterized by high rise buildings, do not care for about the same issues as the neighboring communities in Cuajimalpa. Reaching agreements among different stakeholders will be a big challenge for the water fund board (Cruz, E., personal communication, 2014).

Communication: One of the mayor challenges faced by FAMM is the population's lack of knowledge about the scarcity of water resources and the poor media coverage given to announce the efforts done by the organizations of the water fund. Until now there has been few information on TV or radio issued on the efforts of the FAMM. In the Mexican valley watershed is important to create awareness among the population which in turn can improve the chances of obtaining voluntary contributions for the water fund (Rovalo, M., personal communication, 2014).

Financial resources: In the ideal case the water fund is financed by obligatory (from water consumption) and voluntary payments (which can be based on the valuation of ecosystem services), as well public and private contributions (Aranda, J. L., personal communication, 2014). In Monterrey, it proved to be extremely difficult to involve private water companies in the water fund. The FAMM proposed to the "Water and Drainage Services of Monterrey" company to charge for each hydrant a monthly payment of 1 Mexican peso to generate an income of 12 million pesos each year (Rovalo, M., personal communication, 2014). The proposal was rejected with the justification of avoiding extra taxes. The same company supports the construction of a water pipeline to the Panuco River with a total length of 520 km and an estimated investment of 16 billion Mexican pesos to supply drinking water to Monterrey and its metropolitan area (Gobierno del Estado Nuevo Leon 2014).

CONAGUA participation: The involvement of CONAGUA has been one of the biggest challenges for FAMM and FSA. In Chiapas the responsible institutions are still in the negotiation process and in Monterrey, CONAGUA has shown no interest to participate in the water fund (Rovalo, M., personal communication, 2014).

Resource management: The water fund has to be well funded with an appropriate transparent resource management and reliable institutions (Cota, E., personal communication, 2014). If the water fund is mainly financed by the private sector, a civil association seems to be the best option. If the water fund is financed by public resources, a private company such as a bank will facilitate the resource management (Aranda, J. L., personal communication, 2014).

Portfolio of priority sites: The identification of priority sites is necessary, but it can be a never ending process that can delay the start of the water fund. For the identification of the priority sites it requires a clearly defined participatory approach with a strict time limit (Aranda, J. L., personal communication, 2014).

Learning cost: Sharing the experience of other water funds can help to reduce the learning costs to a minimum (Cota, E., personal communication, 2014).

8 Conclusion

Through this research study several priorities of the influence area are identified and could be assumed for the water forest (Table 16: Opportunities for the water fund). Every priority implies an opportunity for the water fund and increases the necessity to implement this financial mechanism in the water forest. For sure, there are several other financial solutions to attack each priority, but only a few provide a comprehensive approach like the water fund. All the priorities of the study area have to be taken into account for further water fund activities, but two specific areas combine several characteristics that make these still more interesting for the first pilot projects (Figure 21: High priority areas of the influence area).

The stakeholder analysis has shown that there are several environmental CSO using different conservation approaches possible to apply in further water fund activities. According to Rovalo (2014), they can participate in the water fund board and at same time be in charge for conservation activities in the study area. The environmental commissions CONANP, CONAFOR and CONAGUA have strong influence in the area and can support or limit the implementation process. The success for the water fund will highly depend on the flexibility to involve all the different interests of the governmental organization, the private water companies, the research institutes and the interest of the civil society under one common objective.

Finally, the research study provides for governmental and non-governmental organizations working in this area an initial baseline study about the opportunities that can be expected to implement the water fund in the future. For further research studies it offers an overview about the variant studies that can be developed by analyzing the implementation of a water fund. The identified priority areas can be analyzed more detailed by its vegetation cover, land tenure, biological threats or their provision of ecosystem services in future studies.

Table 16: Opportunities for the water fund

Priorities	**Funding opportunities for the water fund**
Several protected areas but few have management plans and assigned staff	Support the development of management plans in the study area and invest in community participation in the management of the NPA.
Only one protected areas registered in the SINAP	Influence on FANP to include more NPA of the study area in the SINAP.
Low and limited payment for ecosystem services	Complement the payments by matching funds of CONAFOR.
Priorities	**Conservation opportunities of the influence area**
Social property predominant land tenure	Collaborate with Pronatura to develop conservation easements, private reserves or usufructs.
Restricted emphasis of PSA program on conservation and forest protection	Develop territorial management plans on community, ejido or plot level and reward integrated land uses management. Collaborate with the CCMSS.
Several threatened species	Collaboration with CONANP to support the admission of the endangered species leptonycteris nivalis to the PROCER. Increased focus on conservation activities in the canyons of Cuajimalpa, in Alvaro Obregon, and La Magdalena Contreras, as well as in the highlands with forested areas, in Tlalpan and Milpa Alta.
Half of the study area is classified as IBA	Align the TNC standard for monitoring water funds to the international monitoring standards of BirdLife.
High expansion of irregular settlements	Involve the policies strategy of the federal district environment secretary for the irregular settlements in its conservation strategies.
Deforestation and agriculture activities	Implement soil restoration activities in the municipalities Altizapán de Zaragoza, Naucalpan de Juarez, Isidro de Fabela, Nicolás Romero, and Milpa Alta.
Stakeholder	**Opportunities of participation**
WWC, GWP, GIZ and USAID, COTAS, watershed councils, CETAMEX, PAOT, PROFEPA, FONADIN, IASA, IMTA, IASA, and Partido Verde.	Inform the stakeholder via general communications, newsletters, websites, and mails with the aim to increase their interest of participating in the water fund.
CI, Reforestamos México, Pronatura México	Support the conservation efforts in Topilejo (D.F.), focus on developing small community enterprises, apply the construction of water collectors in further water fund activities.
CONAGUA	Try to increase their level of interest by engaging them and consulting the water banking system and participate in the watershed council of the Mexican Valley.

CONANP	Involve them in governance and decision making bodies; engage and consult them regularly. Possible collaboration with the starting project “Biodiversity Conservation in the Neovolcanic Axis" and the “Information, Monitoring and Evaluation System for Conservation” (SIMEC).

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ANNEXES:

Annex 1. Expert Interviews

Organization	Contact	Position and knowledge related to water fund or study area	Interview
Agua.org	Jaime Suaste	Network Coordinator: Watershed and city learning community of the Mexican Valley,	14.05.2014
CI	Jürgen Hoth	Project director of the Water Forest Initiative; Scientific Counsellor at the Metropolitan Environmental Commission (CAM)	03.06.2014
Fondo Semilla de Agua	José Luis Aranda Nucamendi	Coordinator of the Upper Grijalva basin, Sierra Madre and Chiapas coast water fund	04.06.2014
FANMex	Nathalie Seguin	Coordinator of the Freshwater Action Network Mexico	Unsuccessful
GIZ	Tobias Wittmann	Main adviser of climate change and protected areas management: Mitigation and monitoring component	09.06.2014
	Juan Antonio Reyes González	National Advisor on Protected Areas and Climate Change at GIZ; Conservation Incentives Coordinator at World Wildlife Fund	09.06.2014
PAOT	Gabriela Ortiz	Technical Coordination and Systems	Unsuccessful
UAM	Dr. Elena Burns	UAM Research Program Sierra Nevada; coordinator of the citizen water law "Water for all, forever", coordinator of the book: "Rethinking the basin: Managing water cycles in the Valley of Mexico"	Unsuccessful
CCMSS	Lucia Madrid	Participates in the council of the water fund Valle de Bravo; In charge of the Integrated Watershed Management / Payments for environmental services project of CCMSS.	29.05.2014
FMCN	Rossana Landa Perera	Coordinator of the Watershed Conservation Program	Unsuccessful
UNAM	The Water Network UNAM (RAUNAM)	Network of knowledge for capacity building and implementation of projects that contribute to the solution of problems facing Mexico in water issues.	Unsuccessful
CONANP	Rocío Penélope Montiel Bustos	Subdivision of strategic projects; Participation in the strategy of the water forest	29.05.2014
CONAFOR	Sofia Cortina	Manager PES	Unsuccessful
	María Dolores Robledo	Project Coordinator matching fund and PES; Reforestation project Tlaxcala	Question answered by mail 6.06.2014

CONAGUA	Maria del Carmen Tejeiro Sánchez	Assistant Manager to support Hydro-Agricultural Infrastructure and Irrigation Districts in the Mexican Valley	27.05.2014
	Jacobo Adonay Salgado Hirschberg	Administration of Water Banks of the Mexican Valley Watershed	27.05.2014
	Ramón Alberto López Flores	Technical Direction of the Watershed of the Mexican Valley Council (OCAVM).	Unsuccessful
TNC	Hilda Hesselbach	Leading the strengthening and development of water funds and other schemes for financing watershed conservation across Mexico and the North of Central America	12.05.2014
Pronatura Mexico A.C.	Edith Caballero	Director of project in the west centre region, Pronatura Mexico; Coordinator of the environmental education project in Ajusco, Mexico.	31.03.2014
Pronatura Mexico A.C.	Eduardo Cota,	Director of Ecosystem Conservation and Restoration Programme; Coordinator of watershed conservation project,	27.03.2014 and 06.06.2014
Pronatura Noreste A.C.	Magdalena Rovalo	General Director; Coordination of the Water Fund Project of Monterrey, Mexico	23.05.2014
Reforestamos Mexico	Emilio Cruz Sánchez	Assistant Manager of public policy for forestry in Mexico, participation in the Water Forest Strategy.	04.10.2014